SCIENTIFIC AMERICAN

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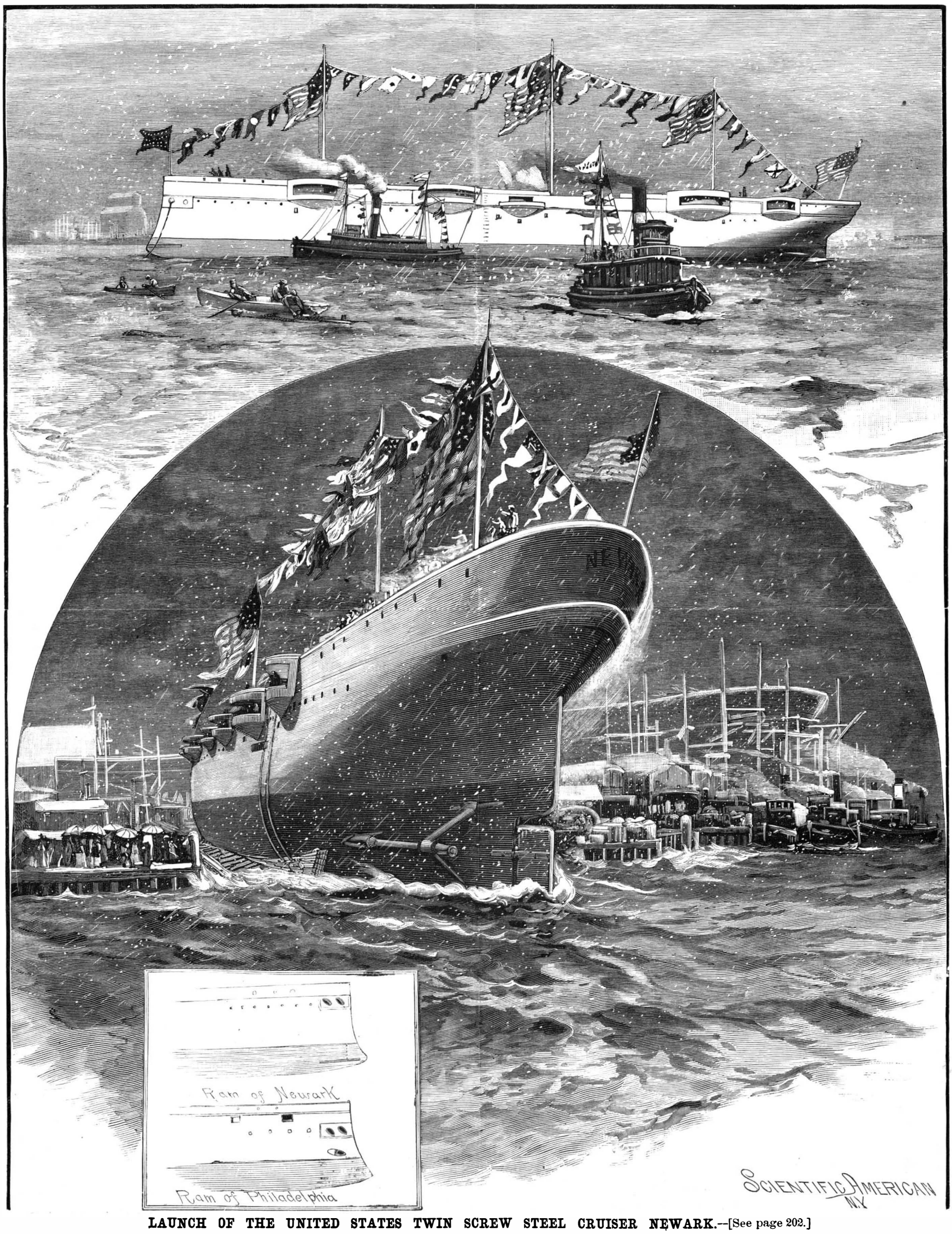

LAUNCH OF THE UNITED STATES TWIN SCREW STEEL CRUISER NEWARK.—[See page 202.]

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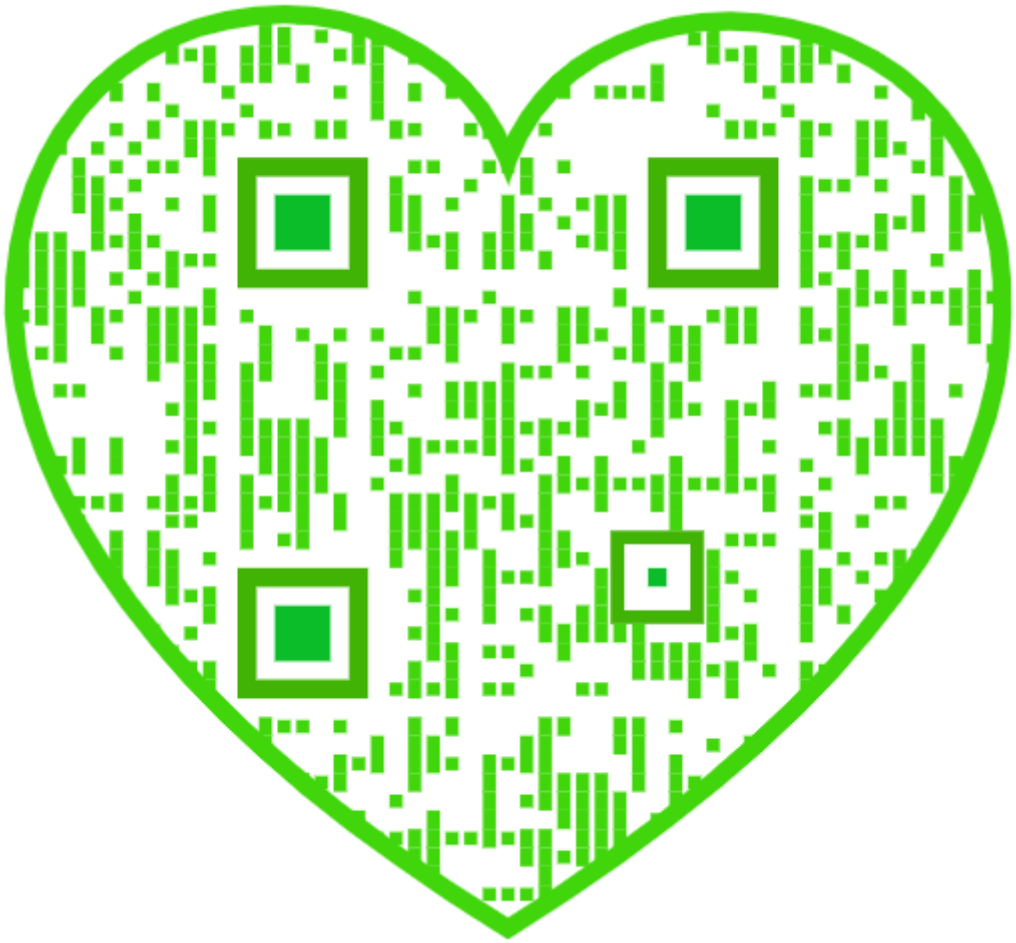

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FORMAL OPENING OF THE GREAT FORTH BRIDGE.

Several weeks ago we gave illustrations of this wonderful structure, showing its appearance as completed and opened for traffic. The official or formal opening, which included the clinching of the "last" rivet, took place on March 4, 1890, under the auspices and in presence of royalty, which in England is considered almost indispensable for such an occasion. The Prince of Wales, heir to the throne, accompanied by a large retinue of titled personages, passed by boat under and then by rail over the bridge, inspected its construction and admired its gigantic proportions. On the return of the royal train a stoppage was made and the Prince alighted; then, guided by Mr. Arrol, the contractor, the Prince placed his hand on the silver cock of a hydraulic riveter, gave it a turn, and thus bended down the "last" rivet. The train then moved along nearly to the end of the bridge, when his royal highness again climbed to the deck of the bridge, hung on to his hat with both hands, for the wind was blowing great guns, and said, or is said to have said, for nobody could hear him, "Ladies and gentlemen, I now declare the Forth bridge open." Back into the car the Prince quickly placed himself, the gale having nearly sucked away his breath.

At the buildings of the bridge works a splendid banquet followed, at which Sir M. W. Thompson presided. In reply to the toast in honor of himself and the royal family, the Prince of Wales made an excellent little speech, containing a variety of interesting particulars relating to the bridge. We give a brief abstract:

"The day has been a most interesting day to all of us, and especially so to me, and I feel very grateful that I have been asked to take part in so interesting and important a ceremony as the one at which we have all assisted. I had the advantage, nearly five and a half years ago, of seeing the Forth bridge at its very commencement, and I always looked forward to the day when I should witness its successful accomplishment. I may, perhaps, say that in opening bridges I am an old hand. At the request of the Canadian government, I performed the opening ceremony thirty years ago of opening the Victoria bridge over the St. Lawrence at Montreal, putting in the last rivet, the total of rivets being one million. To-day I have performed a similar ceremony for the Forth bridge, but on this occasion the rivets number nearly eight millions instead of one million. The construction of the bridge has been on the cantilever principle, which has been known to the Chinese for ages, and specimens of it may be seen likewise in Japan, Tibet, and the northwest provinces of India. Work of this description has hitherto been carried out on small dimensions, but in this case the engineers have had to construct a bridge in thirty fathoms of water, at the height of 150 ft. above high water mark, and crossing two channels, each one-third of a mile in width. Had it not been for the intervening island of Inchgarvie, the project would have been impracticable. It may perhaps interest you if I mention a few figures in connection with the construction of the bridge. Its extreme length, including the approach viaduct, is 2,765 yards, one and one-fifth of a mile, and the actual length of the cantilever portion of the bridge is one mile and twenty yards. The weight of steel in it amounts to 51,000 tons, and the extreme height of the steel structure above mean water level is over 370 ft., above the bottom of the deepest foundation 452 ft., while the rail level above high water is 156½ ft. Allowance has been made for contraction and expansion and for changes of temperature to the extent of 1 in. per 100 ft. over the whole bridge. The wind pressure provided for is 56 lb. on each square foot of area, amounting in the aggregate to about 7,700 tons of lateral pressure on the cantilever portion of the bridge. About 25 acres of surface will have to be painted with three coats of paint. As I have said, about eight millions of rivets have been used in the bridge, and forty-two miles of bent plates used in the tubes, about the distance between Edinburgh and Glasgow. Two million pounds have been spent on the site in building the foundations and piers; in the erection of the superstructure; on labor in the preparation of steel, granite masonry, timber, and concrete; on tools, cranes, drills, and other machines required as plant; while about two and a half millions has been the entire cost of the structure, of which £800,000—nearly one-third of this amount—has been expended on plant and general charges. These figures will give you some idea of the magnitude of the work, and will assist you to realize the labor and anxiety which all those connected with it must have undergone. The works were commenced in April, 1883, and it is highly to the credit of every one engaged in the operation that a structure so stupendous and so exceptional in its character should have been completed within seven years. The opening of the bridge must necessarily produce important results and changes in the railway service of the east coast of Scotland, and it will, above all, place the valuable manufacturing and mineral-producing district of Fife in immediate communication with the south side of the Firth of Forth. When the Glenfarg line, now nearly completed, is opened for traffic, the distance between Edinburgh and Perth will be reduced from sixty-nine to forty-seven miles, and instead of the journey occupying, as at present, two hours and twenty minutes, an express will be able to do it in an hour. Dundee, likewise, will be brought to within fifty-nine miles of Edinburgh, and Aberdeen 130 miles, and no sea ferries will have to be crossed. The construction of the bridge is due to the enterprise of four important railway companies, (1) North British—the bridge is in its district—(2) North-Eastern, (3) Midland, and (4) Great Northern, and the design is that of two most eminent engineers, Sir John Fowler and Mr. Benjamin Baker. The contractor was Mr. William Arrol, and the present Tay bridge and bridge which I have inaugurated to-day will be lasting monuments of his skill, resources, and energy. I have much pleasure in stating that on the recommendation of the prime minister, the Queen has been pleased to create Mr. Matthew William Thompson, chairman of the Forth Bridge Company and of the Midland Railway Company, and Sir John Fowler, engineer-in-chief of the Forth bridge, baronets of the United Kingdom. The Queen has also created, or intends to create, Mr. Benjamin Baker—Sir John Fowler's colleague—a Knight Commander of the Order of St. Michael and St. George; and to confer on Mr. William Arrol, the contractor, the honor of a knighthood."

ROLLER MILL PATENT CASE.

A patent suit of considerable importance, relating to roller mills for grinding flour, has lately been decided by Judge Blodgett in the United States Circuit Court for the Northern District of Illinois.

This was a suit brought by the combination known as Patent Roller Mill Trust, but legally styled the Consolidated Roller Mill Company. These plaintiffs hold several patents, among them the Gray & Odell patents pertaining to adjustments of roller mill rolls, and if their patents could be sustained, they would virtually enjoy the right of collecting royalty from nearly all users of roller mills, since nearly all employ adjustments such as are claimed under the patents.

The plaintiffs had obtained a judgment in their favor in May last, in the Eastern District of Michigan, and it was with great reluctance that Judge Blodgett found himself unable to agree with that decision. It, however, appeared that previous to this favorable decision another decision adverse to the plaintiffs had been given in the Western District of Wisconsin; which latter Judge Blodgett held to be equally as good as the Michigan case. After a most careful consideration of the premises, Judge Blodgett found the plaintiffs were not entitled to any broad claim for their devices, and dismissed the bill. If this decision is sustained by the Supreme Court of the United States, it will give great satisfaction to the roller mill people in all parts of the country, as it will relieve them from royalty payments amounting in the aggregate to very large sums.

POSITION OF THE PLANETS FOR APRIL.

URANUS

is morning star until the 14th, and then becomes evening star. Uranus comes to the front on the April planetary record, for the most important epoch in his course, his opposition with the sun, occurs on the 14th, at midday. He is then at his nearest point to the earth, and is visible to the naked eye. He must be looked for on the 14th in the southeast about 3° east of Spica and 1° 36′ farther north. He rises when in opposition at sunset, and is on the meridian at midnight. An opera glass will be an aid in finding the planet, unless the visual power is unusually good, and 9 o'clock in the evening is a favorable time for observation.

Uranus rises on the 1st at 7 h. 20 m. P. M. On the 30th he sets at 4 h. 19 m. A. M. His diameter on the 1st is 3″.8, and he is in the constellation Virgo.

SATURN

is evening star. His vicinity to Regulus and his convenient position for observation make him, during April, the most interesting member of the brotherhood. After his conjunction with Regulus, on March 28th, he continues to retrograde or move westward until the 28th, when he becomes stationary, then, changing his course, or moving eastward, he again approaches the bright star, being nearly 1° west and 1° 36′ north of it at the close of the month.

Saturn sets on the 1st at 4 h. 7 m. A. M. On the 30th he sets at 2 h. 11 m. A. M. His diameter on the 1st is 18″.4, and he is in the constellation Leo.

MERCURY

is morning star until the 9th, and then evening star. He is in superior conjunction with the sun on the 9th, at 2 h. 22 m. A. M., and commences his swift course eastward from the sun, overtaking Venus on the 25th. The two planets are then in conjunction at 11 h. 10 m. P. M., Mercury being 2° 4′ north. As the planets set about an hour and a half after the sun on the 25th, and are in high northern declination, sharp-sighted observers may find them soon after sunset, Venus serving as guide to her smaller neighbor.

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Mercury rises on the 1st at 5 h. 33 m. A. M. On the 30th he sets at 8 h. 35 m. P. M. His diameter on the 1st is 5″, and he is in the constellation Pisces.

MARS

is morning star, and his movements increase in importance as he approaches opposition. He may be readily recognized in the southeast as a red star of the first magnitude, rising about 11 o'clock on the 1st of the month and at half past 9 o'clock at its close. Southern observers will see him in his best estate, but he is unfavorably situated for observers in this latitude on account of his great southern declination.

Mars rises on the 1st at 11 h. 10 m. P. M. On the 30th he rises at 9 h. 30 m. P. M. His diameter on the 1st is 12″.6, and he is in the constellation Scorpio.

JUPITER.

is morning star. There is no need of pointing him out to the observer who has an outlook on the southeastern sky, for at 3 o'clock on the 1st, and soon after 1 o'clock on the last of the month, he will loom above the horizon and shine with superb brilliancy.

Jupiter rises on the 1st at 3 h. 1 m. A. M. On the 30th he rises at 1 h. 18 m. A. M. His diameter on the 1st is 34″.2, and he is in the constellation Capricornus.

VENUS

is evening star. She will soon emerge from her temporary eclipse in the sunbeams, and prove her claim to be the brightest star in the firmment. She sets an hour and a half after the sun at the close of the month.

Venus sets on the 1st at 7 h. 8 m. P. M. On the 30th she sets at 8 h. 19 m. P. M. Her diameter on the 1st is 10″.2, and she is in the constellation Pisces.

NEPTUNE

is evening star. He sets on the 1st at 10 h. 28 m. P. M. On the 30th he sets at 8 h. 38 m. P. M. His diameter on the 1st is 2″.5, and he is in the constellation Taurus.

Mercury, Venus, Neptune, Saturn, and Uranus are evening stars at the close of the month. Mars and Jupiter are morning stars.

Electrical Calculations.—II.

T. O'CONOR SLOANE, PH.D.

We have seen how to calculate the minimum number of cells of any given battery to supply a specified current through a specified resistance. This is what we termed case *a*. The next thing to be determined is what number of cells should be used to give a fair economy in the consumption of zinc and chemicals. This we have called case *b*.

Where the resistance of the battery is equal to that of the outer circuit, 50 per cent of the energy will be wasted in overcoming the resistance of the battery. If the battery has one-fourth the resistance of the outer circuit, only 20 per cent of energy will be wasted. This may be taken as a fair economy, and the calculations for such a battery are the following:

Divide the resistance of the outer circuit by 4; this gives the proper resistance of the battery. Multiply the resistance of the outer circuit by the current to be maintained, and increase the product by one-fourth of itself; this gives the proper E. M. F. of the battery. The cells are then to be arranged to develop these quantities, as follows:

Enough cells are put in series to give the E. M. F. called for. This number is then multiplied by the known resistance of a single cell, and the product is divided by the proper resistance of the battery. The quotient is the number of cells to be put in parallel.

Assume as before that on the outer circuit a current of $3\frac{1}{3}$ amperes has to be supplied through a resistance of 30 ohms. Assume a battery, one cell of which has an E. M. F. of 2 volts and resistance of 1 ohm. Following the rule just given, divide 30 by 4, giving $7\frac{1}{2}$ ohms as the final battery resistance. Next multiply 30 by $3\frac{1}{3}$, giving 100, and increase this by $\frac{100}{4} = 25$, giving 125 volts as the final E. M. F. of our battery. To develop this voltage, $\frac{125}{2}$ cells are needed in series, giving $62\frac{1}{2}$ cells, or say 63 cells. Multiplying this number by 1 ohm, the resistance of a single cell, and dividing by the final battery resistance, $7\frac{1}{2}$ ohms, we have 8·4 cells in parallel $\left(\frac{63 \times 1}{7\frac{1}{2}} = 8{\cdot}4\right)$. Therefore we put 9 cells in parallel, as wherever a relatively small fraction of a cell is called for, it is well to put in an excess. Our total cells, therefore, are $9 \times 63 = 567$ cells. As combined the E. M. F. is 125 volts, the resistance is 7 ohms. Applying Ohm's law to prove our work, we have $C = \frac{E}{R + R'}$ or $\frac{125}{30 + 7} = 3{\cdot}4$ amperes nearly, or a slight excess of current.

This seems a large number of cells, but economical results cannot be attained with a small quantity of high resistance cells. We may, to illustrate this fact, apply these calculations to two other batteries, assuming the same outer circuit constants in both cases.

Let one high resistance battery have the following cell constants: $e = 1$ volt; $r = 3$ ohms. To develop the 125 volts called for, 125 cells in series are needed. To reduce the resistance to $7\frac{1}{2}$ ohms, we need 50 cells in parallel, $\left(\frac{125 \times 3}{7\frac{1}{2}} = 50\right)$ giving a total of 6,250 cells.

Let the other battery have the following constants: $e = 2$ volts; $r = \frac{1}{4}$ ohm. To develop 125 volts, 63 cells in series are needed. To give $7\frac{1}{2}$ ohms resistance we need 2 cells $\left(\frac{63 \times \frac{1}{4}}{7\frac{1}{2}} = 2\right)$ in parallel, giving a total of only 126 cells.

This shows the importance of a low resistance ratio compared to voltage. Practically, a high resistance battery cannot be used for heavy work. Low resistance may even compensate for low voltage, as in the oxide of copper—caustic soda battery.

Taking a battery of the constants, $e = 2$ volts, $r = \frac{1}{8}$ ohm, it will be found that $1\frac{1}{4}$ cells are needed in parallel for the above conditions. As this is impossible, and as the fraction is relatively too large to neglect, the best plan in such a case is to take the next highest integral number for the cells in parallel and reduce the number of cells in series. Thus, instead of $1\frac{1}{4}$ cells, take 2 cells in parallel, and calculate the constants of such group. They are in this case $e = 2$ volts, $r = \frac{1}{12}$ ohm. Applying the rule given in the former article, we have: Number of groups $= \frac{C\,R}{e - C\,r}$ or $\frac{3\frac{1}{3} \times 30}{2 - (3\frac{1}{3} \times \frac{1}{12})} =$ 58 cells in series and 2 in parallel, a total of 116 cells. Applying Ohm's law to test our work, we have $C = \frac{116}{30 + 4{\cdot}8} = 3{\cdot}3$ amperes. The economy in chemicals and zinc is increased by this procedure, the waste energy being only $\frac{4{\cdot}8}{34{\cdot}8}$ or about 14 per cent.

A New Method of Determining whether Cesspools, Stables, etc., Drain into Neighboring Wells.*

BY PROF. LUCIEN I. BLAKE, UNIVERSITY OF KANSAS.

The present paper has been prepared with a view of describing a simple and inexpensive method of determining whether stables, privies, cesspools, or any other deposits of filth, which may lie in the immediate neighborhood of a well, drain into it. In a common porous soil surface filth in solution may quite readily penetrate to underground water, and thus in the course of time travel a considerable distance and reach a well quite remote. This fact is well known. But it is always uncertain how far and in what direction such travel may extend. The varying circumstances of soil, slope of surface and of rock, depth of well, etc., preclude any general rules.

The eye and the sense of taste form no reliable testing instruments, for the clearest, most tasteless, or most sparkling well waters may yet be solutions of the contents of neighboring cesspools and outhouses, and thus contain the germs of dreaded diseases. Several methods have been tried, from time to time, to trace sources of pollution in wells. A solution of aniline dyes has been poured into such suspected sources, and after a few days the wall water has been examined by the eye for its color. But the eye is only slightly sensitive to a weak solution.

Again, a half bushel or so of salt has been thrown into the filthy places, and the sense of taste called in to detect its presence in the well water, or the water has been analyzed for chlorine.† But the amount of salt required, and the unreliability of the sense of taste,‡ and the expense of chemical analysis render the method unsatisfactory. I am not aware of any process which seems simple, inexpensive, and reliable. Chemical analysis will detect the presence of polluting matter, and thus indirectly suggest its source. But such an analysis requires an expert.

It occurred to the writer to make use of the spectroscope in testing, and the following method of search for sources of pollution in various wells scattered about the city of Lawrence was developed.

It is familiar to all that a glass prism will separate a ray of sunlight into the seven colors of the spectrum. If the ray comes from a metal which is vaporized in a hot colorless flame—as in a Bunsen gas flame—the spectrum no longer consists of all the colors, but of one or more bright bands, characterized by their color and position in the spectrum.

Thus sodium gives a bright yellow band, which is in the position of the yellow of the Swiss spectrum, while calcium gives two, a red and green band, in their proper places. The spectroscope, which is essentially a glass prism and a small telescope to observe the spectrum with, can thus detect by their characteristic bands the presence of substances which can be volatilized in a colorless flame.

Further, there can be no mistake, for no two metals give the same bands. The question arises, Can small quantities of the substances in solutions be thus detected? Prof. Schellen asserts the sure and easy determination of sodium, when less than the 180,000,000 part of a grain is present, and of lithium when less than the 40,000,000 part of a grain. The delicacy of the spectroscopic tests thus exceeds the chemical. Indeed, by the spectroscope several new metals, as thallium, rubidium, caesium, and iridium, have been discovered. For the purpose on hand, then, the spectroscope provides an exceedingly simple method.

A solution of carbonate or chloride of lithium, an ounce to a quart of water, was poured into the suspected sources of pollution in the neighborhood of a well, and after a week or so some of the well water was examined in the spectroscope. Lithium gives one bright red band toward the remote red end of the spectrum. It is impossible to mistake it, even if the solution holds less than one part in one million. The sensitiveness of the test is greatly increased by boiling down the water to be examined, say a quart to half an ounce. A platinum wire is dipped into the water thus prepared, and then held in the flame of a Bunsen burner.

Nine wells were examined situated back of the blocks on the principal street in Lawrence. These wells are located, as regards stables, outhouses, etc., about as is customary in small cities, and their waters are used quite generally for drinking purposes by the families in the blocks. The test showed *direct* communication with a privy 30 feet distant into one of the wells. Other wells are now being tested more thoroughly, as the method was devised too recently to allow sufficient time in a four months' absence of rain for the lithiated water to permeate through the dry soil to the wells. But sufficient has been done, it seems, to show the reliability of the method and the ease of making it.

Physical Laboratory, State University of Kansas, February, 1890.

* Read before Kansas State Sanitary Association.

† See "Water-Supply," W. H. Nichols, p. 132.

‡ See *Science*, Vol. XI., No. 268, "On the Sense of Taste," E. H. S. Bailey and E. L. Nichols.

Short-sighted Inventors.

A few months ago an inventor of certain apparatus of a very simple character, which could have been readily duplicated in many different forms, was offered $6,000 for the right to a certain inland town. He was a poor man and needed the money badly. The reader supposes, of course, that the inventor jumped at the chance and pocketed the money on the spot. Not he; he told the buyer that the patent was worth $100,000, and he was not going to sell one town in New York State for $6,000. The same inventor was offered a similar sum for another large town in the State, or $10,000 for only two cities in the country, but he refused to take it. We have these facts from the inventor himself, and they are correct. Before it was too late to negotiate, we berated the man soundly for his folly, but he was deaf to all argument. The sequel was that the inventor never sold a single right, and has his patent to this day.

The fatuity of inventors on this one point, the value of their patents, is wholly incomprehensible from a business point of view. If a farmer was offered $10,000 for ten bushels of potatoes, and refused it upon the ground that the bushels would produce tons of potatoes, he would be no more inconsistent than the inventor who refuses a good round sum of money for an unmarketed invention. Yet this is what they do every day in the year. There are men walking the streets in poverty who have devices of more or less value, which, in the hands of business men, would have commercial value, that they refuse to part with because they are not paid highly enough in their own estimation.

Let inventors remember, for their own good, that an undeveloped, unmarketed invention is of no more value than the paper the patent is written on. It has possibilities, no doubt, but these last are intangible, and before they can be converted into dollars and cents another head must be called in, and as his risks are greater than the inventor's, he must have an adequate reward. Every patent of any prospective value, even, has to be litigated sooner or later, and this costs money; its value is not established until the absolute priority of the patent is settled. If inventors would only bear these facts in mind, and sell their inventions as soon as possible, there would be fewer disappointed patentees.

[The above from *The Engineer* is good advice, and worth heeding by patentees. Similar incidents to the one related have frequently come to our knowledge, and while it may not be wise to accept the first offer the patentee of a valuable invention has for his patent, it often happens that a better price can be had for a patent when it is fresh from the Patent Office than afterward.—ED.]

Wool Burring in Australia.

The *Illustrated Sydney News* states that one of the wool companies there has a burring machine recently imported from America which effectually eradicates all burrs and other extraneous matter from sheep skins, and its work is done in the most complete manner; skins thickly matted with burr and seed are put through this machine and turned out clean and free, without doing the slightest injury to the wool, while its value is materially enhanced. This is a great acquisition to the company in their fell-mongering department, enabling them to treat the very worst class of skins in a complete and satisfactory manner. There is also connected with these works a tannery on an extensive scale, where from 200 dozen pelts per week are converted into basils of a high class, for which there is a ready market.

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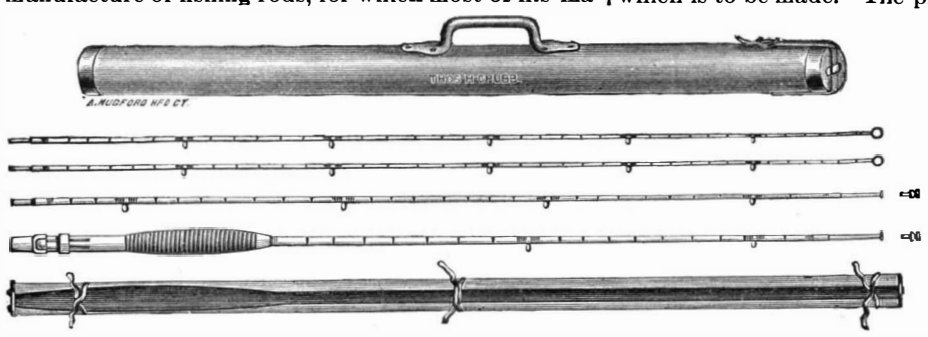
THE MANUFACTURE OF FISHING RODS AND TACKLE.

We present some views in the factory of Thomas H. Chubb, at Post Mills, Vermont, a factory of special interest to sportsmen as well as mechanics, as being organized for the production of a single line of products, the highest grade of fishing rods and of anglers' requirements in general.

The history of its establishment is characteristic. Mr. Chubb, by birth a Southerner, came north to the hills of Vermont in search of health. He first erected a factory for the construction of wooden rakes. As this business did not succeed, he substituted for it the manufacture of fishing rods, for which most of his machinery was available, and early in 1869 he began active operations in this branch of work. The business increased, and eventually some fifty men were employed, when in 1875 the factory was destroyed by fire. The present building was at once erected, three stories and a basement in height, covering an area of 120 × 32 feet, with an addition of 30 × 24 feet.

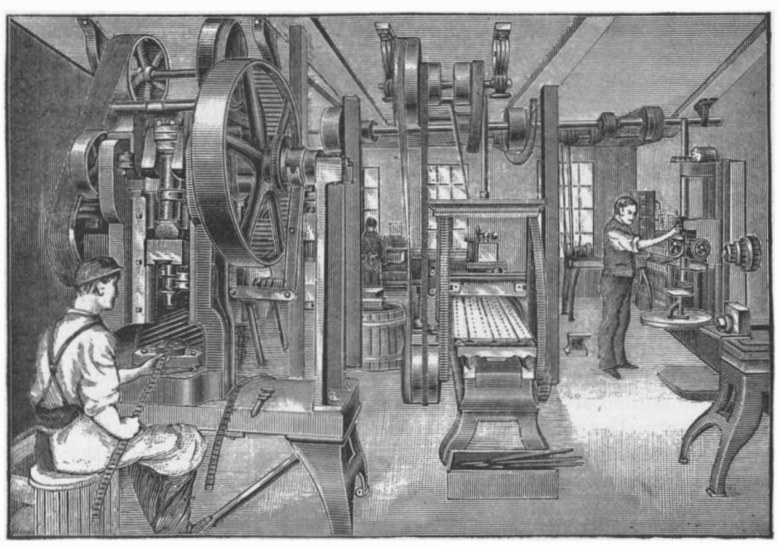


EIGHT-STRIP SPLIT BAMBOO ROD AND LEATHER CASE.

The factory is situated on the banks of the Ompompanoosuc River. Near it is Fairlee Lake, a picturesque sheet of water, some three miles long, which is well stocked with fish. The river supplies water power, all the machinery in the factory being driven by a turbine, a steam engine and boiler being held in reserve in case of accident to the water works.

A large amount of special machinery, much of which was designed by Mr. Chubb himself, is used in the process of manufacture, and some idea of the appearance of the work rooms can be derived from the three views which we give, representing respectively the machine shop, where the heaviest machinery is employed turning out the metal work, etc., the split bamboo room, where the cane is treated, and the finishing room, devoted to work in wood and in metal.

SPLIT BAMBOO ROOM.



MACHINE SHOP.

Three kinds of wood are used in the manufacture; bamboo, imported from Calcutta, is one of the greatest favorites. Our readers are all familiar with the peculiar distribution of fiber in the cane; the outside is coated with a hard enamel, within which comes a fibrous layer. The elasticity and strength of the rod are largely derived from the enamel or outer coating, which has a depth of about 1-16 of an inch. The fibrous material acts as a backing for this portion.

To show the difference between the good quality of highly fibrous bamboo and the poor quality, two illustrations are given, which speak for themselves. The problem now is to construct a rod out of bamboo in which the outer coating alone can be utilized as a vital element. This problem is solved by splitting the bamboo, the direction of the splits following the natural grain, and building up the rod from these pieces. Only the butts are used in the preparation of these split pieces, which have a length varying from three to four feet. They are then accurately shaped, so as to go together somewhat like the staves of a barrel. The outside or enameled part is hardly touched, the natural finish of the wood being carefully preserved.

Either six or eight pieces are used in making a joint, so that when finished the rod has a hexagonal or octagonal section. This very ingenious method of treating the material gives the rod a strength, elasticity, and feel unapproachable in any other way.

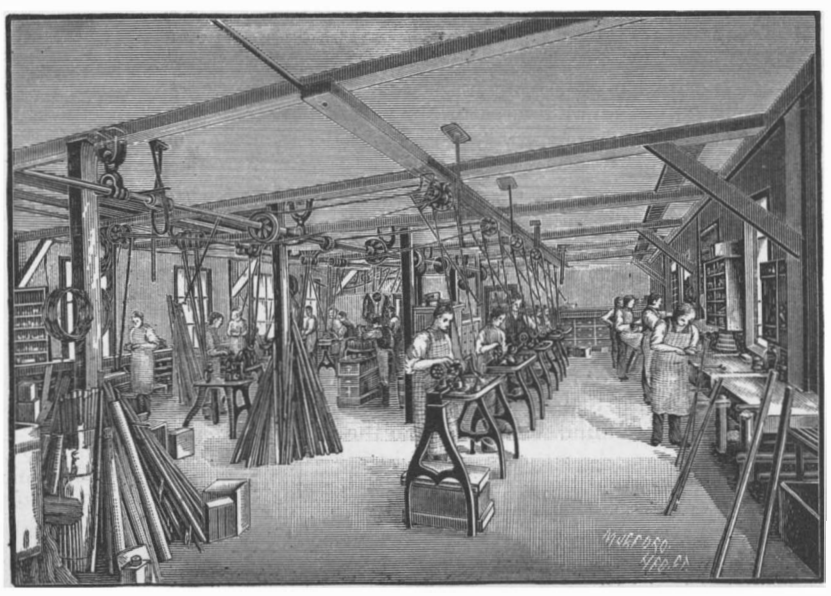
The bamboos imported come in bundles of fifty pieces. They are from 16 to 20 feet long and their butts vary from 1 to 1½ inches in diameter. In the grade of rods made for the retail trade, only four or five pieces in many instances can be secured from a whole bundle.

After being properly shaped by splitting and other processes, the lengths have to be cemented together, either six or eight in number, according to the rod which is to be made. The pieces are put together and held firmly in position until thoroughly saturated with cement. They are firmly bound with linen thread, a special machine being used for this purpose, and then they are put away to dry. Three months' drying at a natural temperature is used. A very light sandpapering and polishing is next applied. Any cement on the outside is removed also and great care is taken in conducting these operations not to impair the natural enamel.

Two other kinds of wood are used besides the bamboo—lancewood and greenhart. These woods are not used immediately, but are stored for two years in order to insure thorough seasoning. The rods made from these materials stand next in value to the split bamboo, but their manufacture does not involve the steps we have just described as being followed in the split rods.

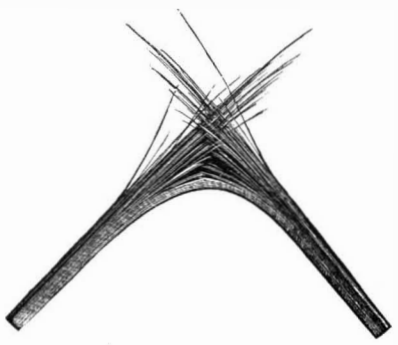
In the finishing of this class of rods they are polished with pumice stone, their pores are filled with whiting and water, and they are shellacked and varnished. In some cases five or six coats are given before the final finish. When the rods are completed, each one is tested by an inspector, who in the case of the higher class rods examines it for the most minute points, exactness of balance included. This inspection is the more necessary, because the maker unqualifiedly guarantees the rod for one year. Although machinery is applied wherever possible, it is found that certain parts of the work have to be done by hand. Thus, all the silk winding on the rods is handwork.

The woodwork is only one part of a modern rod. The metal ferrules, butts, and general trimmings are equally important elements, and these are also made in the same factory. A foundry is kept running for casting brasswork used on rods and for reels. In the finishing shop, already spoken of, the brasswork is completed. It contains lathes for the work upon ferrules, reels, funnel tops, etc. Here the brasswork is turned out ready for use, and here also it is fitted to the different sections of the rods. The finest kind of reels, with other accessories, are manufactured in the same factory.



FINISHING ROOM.

Within the limits of our space it will be impossible to give the most cursory description of the great variety of rods made in the Chubb factory. The 8-strip salmon bamboo rod is a good representative. It is 16 feet long and weighs 26 ounces. It is supplied with two tips; the ferrules are re-enforced, so that no water can ever reach the wood. The Chubb waterproof varnish used on all the rods protects their exteriors perfectly This represents one of the heavier rods. For an example of the opposite extreme, the "Raymond" fly rod may be taken. It is 9 feet long and weighs only 4 ounces. It is of so fine a grade that six and seven pound trout have been caught with it. In making the higher qualities of rods the ideas of representative anglers have been utilized, and the rods in some cases are made from them.



A GOOD PIECE OF BAMBOO.

A POOR PIECE OF BAMBOO.

Among the reels, the Henshall 4 multiplier reel stands perhaps the highest. It is made of German silver of the best quality, with steel gear and pivots throughout. It can be made to multiply either two or four times. It has a mechanical thumb drag, or brake, placed upon the plate opposite the handle, thus being well out of the way of the latter when rotating. It has also an adjustable drag and adjustable click, so that any desired operation can be given to it. It holds 100 yards of fine line. The reel when started will run for a minute and a half to two minutes, its balance and journaling is so perfect.

Among the other accessories made or supplied by the Chubb factory may be mentioned fly books, cases for rods, landing nets with jointed frames, reel cases, and the highest grade of silkworm gut, fishing lines, varnish and stain for rods, etc. For those who prefer to make their own rods, stock is supplied to satisfy every requirement. A very convenient appliance is the fishing rod holder. It is made of malleable iron, with a clamp arranged for screwing to the seat or thwart of a boat. The swivel joint at the top and at the base of the standard, with their axes at right angles to each other, constitute a universal joint in their combined operation, so that the rod can be set to any angle desired. By means of these holders two or more rods may be worked by a single fisherman.

Hooks and flies, made to Mr. Chubb's order, of the very highest grade, are also supplied. In the machinery used and in the products which are manufactured, much patented work is embodied. Many of these patents were taken out by the SCIENTIFIC AMERICAN agency.

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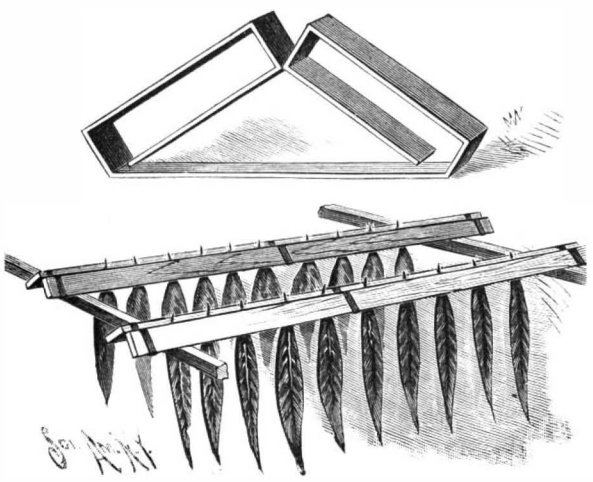
A HANGER FOR USE IN CURING TOBACCO.

The accompanying illustration represents an improved hanger or stick for use in curing tobacco in the leaf in barns and elsewhere, by heat. It has been patented by Mr. Burton B. Edwards, of Marshall, N. C. Each hanger is composed of two wooden side pieces, preferably about 3½ feet in length, ⅜ inch thick, and 1½ inch wide, held together in inverted V-shape by



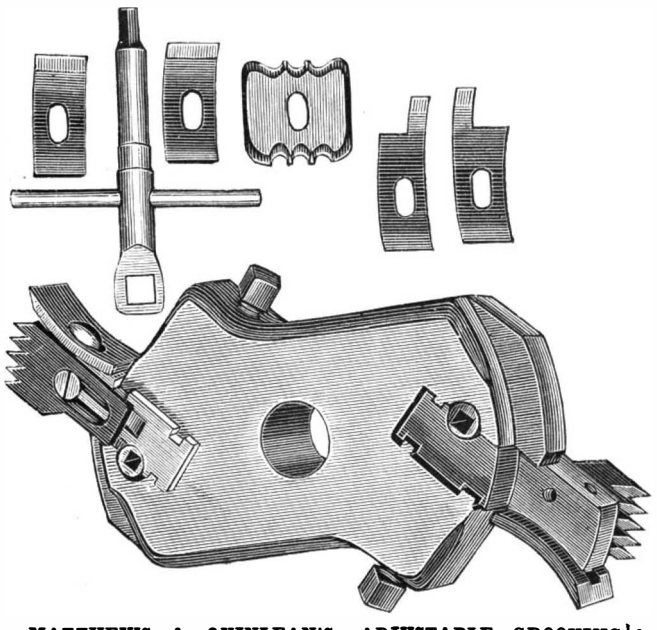
EDWARDS' TOBACCO HANGER OR STICK.

transverse spring clamps arranged at suitable distances apart, three such clamps being ordinarily sufficient, although four clamps may be used with a hanger five feet long. These springs may be made of either steel or hard brass, in the latter case being preferably stamped out of a single piece, or if made of steel being formed as shown in the upper part of the illustration, by a narrow band of thin metal, bent upon itself to form side pockets for the wooden strips, which are thus held to pinch at their meeting edges. The leaves when suspended for curing are clamped between these meeting edges, so that the metal does not come in contact with the tobacco, and the device may be readily taken into the field for filling to facilitate the commencement of the curing as soon as the ground leaves begin to ripen, so that by the time it is usual to cut the tobacco, the whole crop may have been gotten out of the way. The inverted V-shape of the stick allows the heat to concentrate or accumulate, so as to cure the butts of the leaves as fast as the bodies of the leaves. The sticks may be taken separately to the field and put together as needed, the spring clamps being fitted so as to be readily slipped on and off the wooden strips, this facility of putting the stick together and taking it apart being also of great advantage as regards shipping and storing the sticks.

For further information relative to this invention address the Piedmont Tobacco Stick Company, Marshall, N. C.

AN IMPROVED ADJUSTABLE GROOVING HEAD.

An adjustable dado or grooving head, capable of attachment to any saw, mandrel, or arbor, and by which, without removing the cutters, the width of the groove to be cut may be varied, has been patented by Messrs. Francis I. Matthews and Daniel J. Quinlean, of Livermore, Cal, The head has perfectly smooth side faces, whereby adjustment may be made upon either side as may be found convenient, and the device will oc-

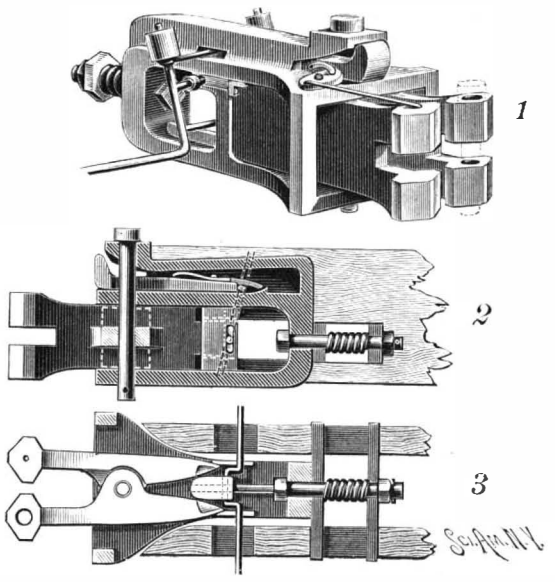


MATTHEWS & QUINLEAN'S ADJUSTABLE GROOVING HEAD.

cupy no more space upon the arbor when expanded to its greatest extent than when in position to cut the narrowest groove. The illustration herewith represents a form of grooving head or dado which they make, styled the "Chief," the small figures showing different forms of knives and the key employed in fixing them in place. By their recently patented invention the carrier blocks are held to place by a beveled clamping block fitting in a recess in the periphery of the head, a set or cap screw passing through this block into a threaded cavity in the base wall of the recess. Adjusting screws are also provided, by turning which the carrier blocks with their attachments will be moved laterally in opposite directions, thus producing a narrow or a wide groove. The adjusting screw is preferably given about sixteen threads to the inch, so that one turn of the screw will move the knife or cutter about one-sixteenth of an inch, and a graduating circle is produced on the head around the adjusting screw, which, in connection with a line across the center of the screw head, will enable the operator always to regulate the adjustment to a small fraction of an inch.

AN IMPROVED CAR COUPLING.

The coupler shown herewith is designed for use also with a link and pin drawhead, and to be operated from the sides or top of the car. It has been patented by Mr. Morgan D. Kalbach, of Harrisburg, Pa. Fig. 1 shows the device in perspective, Figs. 2 and 3 being vertical and horizontal sections through the drawhead. Within the opening of the drawhead are pivoted two knuckles, whose outer ends extend beyond the front of the drawhead. One knuckle has two leaves and the other a single leaf at the pivotal point, the single leaf of one knuckle passing between the two leaves of the other. At the rear of the knuckles a locking block is held to slide, the block having at its rear end a slot, through which passes the crank arm of a rock shaft, the latter extending out through openings in the drawhead, and the upper extremities of its end projections



KALBACH'S CAR COUPLING.

being weighted, while a crank arm is also extended from the rock shaft for manipulation at the side of the car, being likewise connected by a rod with the top of the car. Upon the top of the drawhead, at one side, is centrally pivoted a lever, which is connected at one end by a link with a sliding spring-held latch located in a horizontal chamber in the drawhead, the lever being connected at its other end by a link with one of the knuckles. The opposite knuckle has an opening from top to bottom for the reception of a coupling pin, and a horizontal recess, in order that a link may be employed, the other knuckle also having a similar horizontal recess produced therein. To set the drawhead to couple with an opposed coupler, it is only necessary to press down upon the crank arm at the side or from the top of the car, whereupon the latch is operated to work a lever to force the outer ends of the knuckles apart. Upon contact with the knuckle of an opposed drawhead, the latch is forced inward and the knuckles are made to approach one another, while the locking block is forced between the inner ends of the knuckles, preventing the opening of their forward ends to the unlocked position.

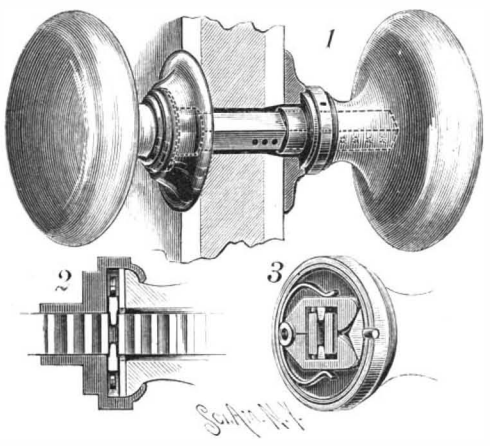
A Gas Holder without Framing.

In our SUPPLEMENT, No. 668, we described a gas holder in whose construction it was proposed to dispense with the guide frame invariably used hitherto. Spiral tracks or ways were to be provided inside of the tank, along which rollers attached to the lower circles of the outer section traveled, while similar ways were to be arranged inside of the outer sections. The plan seemed a bold innovation, but has recently been put into practice. In Northwich, England, a holder constructed on this principle, the invention of Messrs. William Gadd & W. F. Mason, was inaugurated some weeks ago. It has a capacity of 109,000 cubic feet, is 58 feet in diameter, and 40 feet high in two lifts. This is large enough to give a thoroughly practical test, and the future history of the holder will be watched for with interest.

THE law compels no one to do impossibilities.

AN IMPROVED DOOR KNOB ATTACHMENT.

A simple means of attaching door knobs to square spindles, the attachment being easily adjusted to a door of any thickness, and suitable for any kind of knob, is illustrated herewith, and forms the subject of a patent issued to Mr. Samuel H. Berrey, of No. 100 Pavilion Avenue, South Providence, R. I. Fig. 1 is a side view showing the application of the improvement, Fig. 2 being a longitudinal section of one end of the

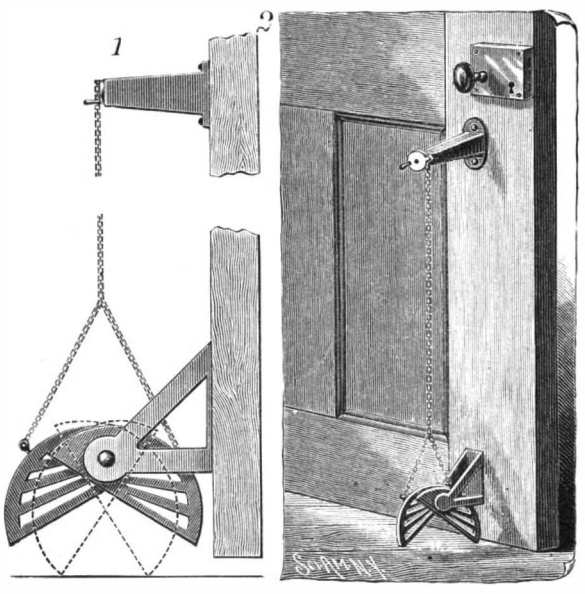


BERREY'S DOOR KNOB ATTACHMENT.

lock spindle where it is attached to one knob, and Fig. 3 a transverse section, showing the spring-actuated tumblers and pins engaged with the holes in the lock spindle. The shank of one door knob is attached in the usual manner to the lock spindle, the other end of which has a series of holes, and upon this end the shank of the other knob is made to slide and is adjustably attached. For this purpose the second shank has an annular chamber, to one side of which are pivoted two tumblers fitting closely around the lock spindle, as shown in Fig. 3, and each having a pin which fits into opposite sides of the holes of the lock spindle, the tumblers and pins being retained in locked position by a spring. The free ends of the tumblers are rounded, and opposite these ends is a wedge whose outer face has a shank projecting to the outside of the shank of the door knob, so that by pressing on the shank the wedge will be forced between the rounded ends of the tumblers, throwing them apart and leaving the knob free to slide on the lock spindle. A spring washer incloses one of the door knob shanks, to take up any slack there may be in the parts and insure a perfect fit on the door.

AN IMPROVED DOOR CHECK.

A device whereby a door or gate may be held open at any desired angle, or retained closed if necessary, is shown in the accompanying illustration, and has been patented by Mr. Samuel J. Dohrmann, of No. 402 West Main Street, Louisville, Ky. Fig. 2 shows the device applied to a door, Fig. 1 being an enlarged edge view. The check or stop consists of two arc-shaped segments pivoted in a bracket secured low down on the door, while near the door lock a disk is pivoted upon a projecting bracket, the disk having a limb or crank handle at its periphery. To this disk is fastened a chain, which is connected at its lower end with two short chains attached to the curved



DOHRMANN'S DOOR CHECK.

rims of the segments. By moving the handle upward, to give the crank disk near the lock a partial revolution, the lower corners of the segments are swung downward, as shown in dotted lines, to engage the floor surface, and prevent the movement of the door in either direction. The segments may also be lowered when the door is closed, when they serve as a lock to prevent the opening of the door until they are raised.

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Railway Shop Industries.

Very few visitors to railway shops have any idea of the number of distinct occupations with which the numerous workmen seen are busied. Indeed, we doubt if many of the shop officials and hands themselves realize how many trades and vocations are represented among their co-workers. The following list of actual workers at the shops of a large Eastern road, copied from a blank of that road, will prove not only interesting but surprising to a good many of our readers:

WORKING BY THE MONTH.

- Master mechanics.
- Foreman car repairs.
- General foremen.
- Draughtsmen.
- Engineer of tests.
- Inspectors.
- Chemist.
- Chemist assistants.
- Clerks.
- Timekeepers.
- Storekeepers.
- Messengers.
- Foremen.: Machinists. / Boiler makers. / Blacksmiths. / Hammer shop. / Car repairers. / Car builders. / Car cleaners.
- Foremen.: Carpenters. / Planing mill. / Engine house. / Tin, copper, and sheet iron work. / Foundry. / Pattern shop. / Painters. / Laborers. / Rail shop.
- Stationary engineers.
- Car inspectors.
- Car cleaners.
- Watchmen.
- Pipe fitters and plumbers.
- Gas makers.
- Oil mixers.
- Shifting conductors.
- Water tank repairers.
- Scale repairers.
- Test dept. assistant.

WORKING BY THE HOUR.

- Air brake inspectors and repairers.
- Axle turners.
- Apprentices.: Blacksmiths. / Boiler makers. / Copper and tin smiths. / Car builders. / Machinists. / Moulders. / Painters. / Pattern makers. / Upholsterers.
- Ash pit cleaners.
- Blacksmiths.
- Blacksmiths' helpers.
- Boiler makers.
- Boiler makers' helpers.
- Boiler washers.
- Bolt makers.
- Bolt cutters.
- Bricklayers, masons, and slaters.
- Bricklayers, masons, and slaters' helpers.
- Coppersmiths.
- Coppersmiths' helpers.
- Callers.
- Coal and wood heavers.
- Carpenters.
- Car inspectors, passenger.
- Car inspectors, freight.
- Car builders in shop, passenger.
- Car builders in shop, freight.
- Car repairers in yard, freight.
- Car cleaners.
- Car oilers.
- Drillers.
- Dynamo attendant.
- Engine: Cleaners. / Dumpers. / Preparers (firing up, etc.) / Inspectors.
- Electro replater.
- Flue setters.
- Flue setters' helpers.
- Flue welders.
- Flue cleaners.
- Foundrymen: Core makers. / Cupola men. / Moulders. / Helpers. / Melters and help.
- Gang foremen of: Laborers. / Pits. / Engine house. / Rods, etc.
- Gang foremen of: Copper and tin shop. / Machine tools. / Car repair shop, passenger. / Car repair shop, freight. / Engine cleaners. / Painters. / Planing mill.
- Hammersmen.
- Hammersmen helpers.
- Hammer boys.
- Heaters.
- Hostlers.
- Laborers: Machine shop. / Car shop. / Paint shop. / Lumber yard. / Foundry. / General.
- Lumber inspectors.
- Machinists.
- Machinists' helpers.
- Machine hands, planing mills.
- Machine hands, helpers.
- Machinery oilers.
- Messengers.
- Nut tappers.
- Pipe fitters, shop.
- Pipe fitters, water works.
- Pipe fitters, water works, helpers.
- Painters.
- Painters' helpers (cleaners, etc.)
- Pattern makers.
- Smoke stack inspectors.
- Stationary engineers.
- Stationary firemen.
- Shifting brakemen.
- Sand driers.
- Speed recorder men.
- Sheet iron workers (light).
- Sheet iron workers' helpers.
- Spring maker.
- Spring maker helpers.
- Tender truck repairers.
- Tinsmiths.
- Tinsmiths' helpers.
- Time keepers.
- Turntable men.
- Upholsterers.
- Watchmen.
- Wipers (see engine cleaners).
- Wheel borers.

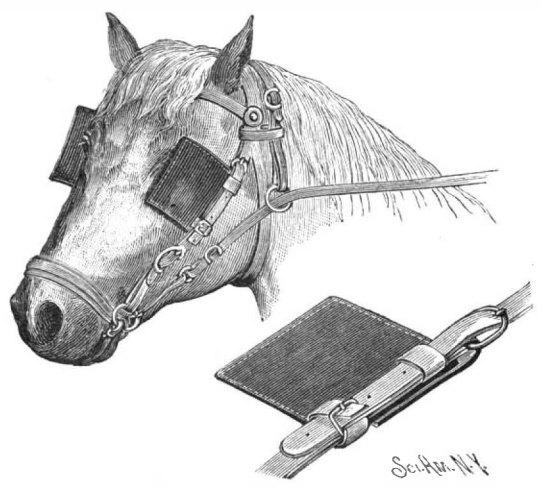
Here are 143 different classes of employes recognized on the wages sheet. There are not 143 different trades, for, as will be seen, there are blacksmiths, blacksmiths' apprentices and foremen of blacksmiths, and so on, yet after allowing for these duplications the number of distinct trades represented is notable.—*Railway Master Mechanic.*

Railroads in South America.

In a recent issue the Chicago *Tribune* says: "The proposed intercontinental railroad which is to connect North and South America, starting southward from the city of Mexico, is now supplemented by a proposition from H. C. Parsons, of Virginia, to build another road, less than 2,000 miles in length, beginning at Cartagena, on the northern coast of Colombia, thence running south through Ecuador to Cuzco, in Peru, where it will connect with the road already building northward from the Argentine Confederation. A company has already been formed under a charter from the State of Virginia, and trustees appointed, the latter being Judge Granville P. Hawes, of New York; Ex-Senator T. M. Norwood, of Savannah, Ga.; John W. Thompson, a Washington banker, and A. W. Campbell, of Wheeling, W. Va. The first step to be taken will be the survey of the route, and for this a fund of $500,000 has been raised. Great difficulties will stand in the way, especially among the mountains, as huge peaks will confront the surveyors in Ecuador and Bolivia, but in these days of science it is premature to consider anything insurmountable, and the success which has crowned the efforts of the builders of the road running east and west in piercing the Andes with tunnels will be encouraging to the projectors of the north and south road. The new road, it is claimed, will pass through an exceedingly fertile country to the north, in many sections rich in gold and silver, and abounding in coal and timber. A considerable portion of the road will run through an almost virgin region, very sparsely populated, but once opened up the projectors are certain that its natural resources will attract a large colonization. The country penetrated by the road is one of the most picturesque in the world, and the enthusiastic projectors are confident that within five years it will be the favorite route of tourists, instead of the European. It will, at least, be a new experience when the traveler can purchase his through tickets from New York to Chicago, thence to the city of Mexico, through Central America, and down through the wild scenery of the Andes to the heart of Peru, thence eastwardly through Bolivia, Buenos Ayres and Brazil to Rio Janeiro, and home by steamer to New York. For some time to come it is evident that human enterprise and energy will concentrate themselves upon the great work of opening up Africa and South America, the one to civilization, the other to commerce. England seems destined to accomplish the one, and the United States, if she is quick to seize her opportunities, the other.

AN IMPROVED BLIND FOR BRIDLES.

The accompanying illustration represents a blind designed to be quickly attached to or detached from a bridle of any kind. It has been patented by Mr. Elias Lindblom, of Biggsville, Ill. Each blind has the usual



LINDBLOM'S BLIND FOR BRIDLES.

flap, on one side of which is a strap extending a short distance beyond the upper edge of the flap, and having an aperture near its outer end to receive the tongue of a buckle before the side strap of the bridle is secured on the buckle. In the same side of the flap of the blind is also formed an opening adapted to receive a short strap having a buckle on one end, this strap holding the bridle strap and the strap attached to the bit ring in position against the edge of the blind. When the blind is to be attached to the bridle, the aperture in the strap extending beyond the edge of the blind is passed over the tongue of the buckle on the strap attached to the bit ring, the bridle strap being then secured to the same buckle in the usual way, after which both straps are secured in position against the edge of the short strap secured to the latter.

Medicated Liquid Soaps.

In a paper read before the recent congress of Russian Pharmaceutical Societies, Herr Saidemann called attention to the therapeutic value of liquid soaps, which he claimed to present the advantages of being more suitable for inunction, favoring admixture of medicinal substances, and being always producible from vegetable oils, thus avoiding the use of animal fats (*Phar. Zeit. Russl.*, Dec. 24, p. 820). The formula recommended by him for a liquid soap is to mix 1 part of caustic potash dissolved in an equal weight of water with 4 parts of olive oil and one-fourth part of alcohol, and shake it vigorously during ten minutes. The mixture is repeatedly stirred during the next hour, then mixed with an equal quantity of water, and after standing several days filtered.

The author states that carbolic acid incorporated with a potash soap has its caustic and poisonous properties paralyzed, while its disinfectant action appears to be increased. It is also stated that the Berlin District Sanitary Commission has found a solution of potash soap in 10,000 of water completely to prevent the development of the splenic fever bacillus, and has recommended a solution of 15 parts in 10,000 as one of the best disinfectants.

THE maker of an accommodation note is bound to all other parties as if there were a good consideration.

A Story of Early Petroleum Days.

Quincy Robinson related an incident of the early history of the oil regions recently, which may give the children of the present generation a vague idea of the magnitude of the transactions which took place when oil was $8 and $9 a barrel, and poor people gained a competency by scooping it off the surface of creeks, or gathered it from pools around the tanks which had overflowed. The story as told by Mr. Robinson was as follows:

"Within a month after Colonel Drake had struck the first petroleum ever brought to the surface in America by means of drilling, my father and the father of my relatives here bought a tract of land comprising 1,280 acres, adjoining the farm on which the Drake well was located, for $350,000. Not long afterward I was sitting in their office one day—I remember it as distinctly as though it happened only yesterday—when an agent for an Eastern syndicate walked in and offered $500,000 for the 1,280 acres. The owners looked at him rather incredulously for a moment, but before they could speak he had counted out on the table $500,000 in cash and drafts which he offered for a deed of the tract. I was appalled by the sight of the pile, but my father and the father of these gentlemen retired for consultation, and decided that if the property was worth $500,000 it was worth $1,000,000, and the offer was refused. Their heirs still own the land, and now it is valued at $20,000. Where they could have got dollars we could scarcely get nickels. Thus you can see what seemingly fairy stories could be told of those days. They are almost incomprehensible to the present generation, but they were red hot facts," and a sigh of regret that the offer had not been accepted went round the circle.—*Pittsburg Dispatch.*

The Forth Bridge.

This great bridge was formally opened on March 4. The construction was begun in the early part of 1883. The amount expended on the bridge works up to the present time is, in round numbers, $16,000,000. The following table of the principal dimensions, taken from the volume on the Forth Bridge, by Mr. Philip Phillips, one of the resident engineers at the works, will be found interesting:

Total length	Upward of 1½ miles.
Cantilever arms projection (outer)	680 feet.
Depth of cantilevers over piers	342 "
Depth at ends	41 "
Distance apart of lower members at piers	120 "
Distance apart of lower members at ends	31·5 "
Diameter of largest tubes	12 "
Top members, distance apart at vertical columns	33 "
Top members, distance apart at ends	22 "
Struts, largest diameter	8 "
Ties, greatest length	327 "
Central girder, span	350 "
Central girder, depth at center	51 "
Central girder, depth at ends	41 "
Internal viaduct spans, various	39 feet to 145 "
Total amount of steel in bridge	over 50,000 tons.
South approach viaduct, total length	about 1,980 feet.
South approach viaduct, average span	168 "
Wind pressure allowed for	56 lb. per square foot.
Depth of water in channels to be spanned	218 feet.
Height of cantilever pier (masonry) above water	209 "
Greatest air pressure in working the caissons	32 lb. above atmosphere.
Weight on a single pier	16,000 tons.
Thickest steel plates	1¼ inches.
Length of plates used in tubes alone	40 miles.
Greatest depth of foundations	88 feet below high water.
Contraction and expansion allowed for	between 6 and 7 feet.

The designers of the bridge were Sir John Fowler and Mr. Benjamin Baker, C.E., while the contractors for its construction were Messrs. Wm. Arroll & Co.

The Weight of Earth Worms.

Darwin estimated that worms, by swallowing earth for the sake of the vegetable matter it contains and forming castings, bring to the surface as much as ten tons of earth per annum on an acre. Worms are great promoters of vegetation by boring, perforating, and loosening the soil, and rendering it pervious to rains and the fibers of plants, by drawing straws and stalks of leaves and twigs into it, and, most of all, by throwing up such infinite numbers of lumps of earth called worm casts, which form a fine manure for grain and grass. The earth without worms would soon become cold, hard-bound, void of fermentation, and consequently sterile; this has occurred in many cases where the worms have been either accidentally or intentionally destroyed, and the fertility of the soil thus lost has only been restored when the worms had again collected and resumed their fertilizing work.

SOME one has said that boasting of what you will do is as unwise as to advertise your prosperity. If your plans are good ones, some one else will catch them up and be in the field in time to divide the advantage with you. If they are not good, you may be certain no one will point out the errors in them, so that you cannot possibly gain aught by your communicativeness. The men who listen well, and are not in haste to impart their own secrets, are the ones who generally get along in the world.

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Correspondence.

Sun Spots.

To the Editor of the Scientific American:

I write to call your attention to a slight error in your last issue in regard to the sun spots.

In the interval you mention of 68 days there were visible two groups of solar spots.

One of these, on October 15, had about eight small spots, and the second, on November 28, had two well defined spots.

These observations are in all probability correct, as they were observed by both Prof. Leavenworth and myself. F. W. PEIRSON.

Haverford College, Montgomery Co., Pa.

What a Canadian Engineer Thinks of the "Scientific American."

Your issue of the 15th inst. is more than especially interesting and instructive, containing, as it does, a description of the "San Diego Irrigation System," "The Rotation of Mercury," "The Manufacture and Use of Aluminum," "Poulet's Manual Instruction of the Mechanic," "The Caliber, Size, and Range of the Guns now being Cast in Rhode Island," "The Proposed Great Bridge between New York and Jersey City," "The New Dry Dock at Halifax, N. S.," "The Mummy Cats of Beni Hassan," "The Pike's Peak Railway," etc.

I have been a subscriber of your paper for the last 30 years or more, and have much satisfaction in recommending the SCIENTIFIC AMERICAN to the world at large, as probably the best, the most generally useful, of all the periodicals I am acquainted with.

Being an architect and engineer, given to scientific research, it may not seem strange that I should thus hold in estimation a journal containing so much of the technical information I am constantly in quest of; but as a more tangible and practical proof of the general interest taken in your publication, by even unprofessional men, I will say that two of my friends, to whom I am "at home" on every Tuesday evening, A. G. Touranque, Esq., an ex-M.P. and an ex-mayor of Quebec, and F. D. Tims, Esq., assistant auditor of the Province, have, independently and unsolicited, expressed the opinion, frequently reiterated, that of all the papers they see—my Canadian friend at the "French Institute," my Hibernian friend at the rooms of the "Literary and Historical Society"—the SCIENTIFIC AMERICAN is the first they look for.

Again let me say that of all the papers received at the "Garnisus Club" in this city, and which are regularly put up at auction at the end of each week, the SCIENTIFIC AMERICAN is that which of its kind brings the highest bid. C. BAILLAIRGE,

Quebec, March 17, 1890. *City Engineer.*

Artificial Refrigeration.

In a recent paper read by Mr. M. C. Bannister before the Liverpool Engineering Society, he said:

The best and most recent arrangement for refrigerating was that made by the Linde British Refrigeration Co., Limited, under the patents of Mr. Banfield. The cold brine was circulated through a shallow trough, in which revolved a number of shafts, each geared together, and driven by any mechanical means available. On the shafts were fixed a number of wrought iron disks, partly immersed in the brine, which cooled them down to the brine temperature as they revolved. Over these disks a rapid circulation of air was passed by a fan, being cooled by contact with the plates; then it was led into the chambers requiring refrigeration, from which it was again drawn by the same fan; thus, all moisture and impurities were removed from the chambers and deposited in the brine, producing the most perfect antiseptic atmosphere yet invented for cold storing; while the maximum efficiency of the brine temperature was always available, the brine being periodically concentrated by suitable arrangements. This system had all the advantages of cold air machines, without any of the disadvantages, and could be worked at almost one-sixth of the cost.

Artificial ice making had now become a common commercial business, and was every day being more and more extended. It was some 25 years since it was first manufactured on any large scale; but there were now, in the aggregate some 100,000 tons made every day in various parts of the world, besides refrigerating and cooling plants equivalent to five times that amount; and the demand was still increasing by bounds—in fact, the supply now could not meet the demand.

CANNOT some one produce a better wagon wheel than at present exists? While American wheels are the best in the world, American roads are in the same or a greater proportion the worst, and there is needed a wheel which will have a strong yet elastic tire, something that is more enduring than the rubber tire, which is in use to some extent, but not with every degree of satisfaction.

Professional Water Finding.

In the month of December last we were requested by Messrs. Heerdegen & Schnee to make an investigation of the claim of the former gentleman as to his ability by means of an instrument he had invented to discover subterranean water. This gentleman is an electro-technical engineer, as it is termed in Germany, Bavarian by birth, but recently residing in Russia, and it was when there that he accidentally made the discovery of the principle of his apparatus. He brings with him a record of the most complete success attending his efforts in Russia, and the certificates to this effect, and the recommendations from houses of the highest standing in Moscow and elsewhere, leave no doubt as to a genuine belief there in his powers or those of his instrument.

We have endeavored to test the accuracy of the claim, but from the outset we were confronted by two obstacles in the way of arriving at perfectly conclusive results. Throughout the test we have had the advantage of the co-operation of the *Engineering News*, Mr. A. M. Wellington or Mr. M. N. Baker being present at all of them.

The first difficulty in the way of making an exhaustive investigation lies in the fact that the instrument is not patented, and that, therefore, Mr. Heerdegen declined to give us details of its construction; and although we were allowed to see and to handle it, and even to try its operation ourselves, we were unable to follow the principles that govern its actions.

The other difficulty to be contended with was that Mr. Heerdegen's claim is to be able to locate underground springs or streams under natural conditions, and it is evident that the only method of testing this conclusively would be to select a site where there was no knowledge or presupposition of subterranean water supply, and in case of a well being located, to sink to more than the depth indicated by Mr. Heerdegen.

Mr. Heerdegen was, however, willing to waive these natural conditions in their strictness, believing that the instrument would enable him to locate running water equally well in iron pipes or in brick or in masonry conduits, and on this supposition the trials were carried out.

The first tests were made on the line of the new aqueduct in the neighborhood of Sing Sing, the points being selected by Mr. Charles N. Gowen, division engineer, who was also present at the trial. The aqueduct being here far below the surface, and no shafts being visible from the points selected, there is no possible clew to its location, especially to a stranger, and yet at two of the three points a large body of flowing water was located with wonderful exactitude as to the position, though inexact as to depth. It is only fair to state that the day was most unfavorable, being the very reverse of what Mr. Heerdegen stated as a prerequisite for accuracy. The second tests were upon the old aqueduct in New York, and they resulted in an accurate determination in one case, and slightly inaccurate in the other, and here again the difficulty of getting a satisfactory artificially arranged test was apparent, as we discovered on making inquiries of the city water department that the rock surrounding the aqueduct at this doubtful point was full of springs, which may have had a stronger influence upon the operation than the artificially conveyed water in the conduit.

The foregoing tests were followed by an experiment rather than a test, which consisted in laying about 150 feet of ¾ inch steam hose on the second floor of the Raub building, at the corner of Nassau and Fulton Streets, Mr. Heerdegen being stationed upon the third floor before the hose was uncoiled. This hose was passed in through various rooms, a stream of water being sent through it, and Mr. Heerdegen succeeded fairly well in tracing upon the floor above its general direction and course.

The last test at which we were present was the most satisfactory and conclusive in every way, the elements of uncertainty being eliminated as far as possible, the locality selected being outside the gate of the National Storage Company, near Communipaw, where the supply of water under pressure to these premises is large and entirely removed from all other pipes, drains, etc., and of course without any indication of its location. This pipe Mr. Heerdegen located with wonderful accuracy and without hesitation, tracing it so nearly correctly that the engineer, Mr. Slater, who had laid it some years previously, and who was present, stated that it was substantially correct. This case was one in which, if Mr. Heerdegen had found it at first only by chance or by a shrewd guess, it would have been impossible for him to have repeated that guess successively three times.

During the occurrence of these tests, fortunately, the opportunity was given to test Mr. Heerdegen practically as a well finder. Mr. Adolph G. Huffel, the brewer at 161st Street and Third Avenue, New York, desired to have a well located at his brewery, where he had already drilled to the depth of 1,300 feet without finding water. As related by Mr. Huffel, "Mr. Heerdegen went over the ground in the neighborhood of the brewery with his instrument, and discovered water on the west side of our property, and expressed his belief that water would be found within 30 or 40 feet of the surface in considerable quantities, and that the stream was 20 inches wide. Mr. Heerdegen traced the stream for about 1,000 yards, and pointed out in this distance four places where the same stream could be struck. Having selected the place most convenient to us, we commenced boring, and at a depth of 31 feet struck the stream. The water rose to within 10 feet of the surface, and a pump having been introduced, the well yielded 50 gallons per minute for 120 hours without cessation."

We have satsfied ourselves of the correctness of these facts and of the quantity of water given by the well.—*Engineering and Mining Journal.*

The Musical Understanding of Animals.

A London *Globe* correspondent writes: A German paper states that experiments have recently been made in Lippe and Westphalia to ascertain whether military horses understand the bugle calls. The committee appointed have come to the conclusion that the animals have no clear comprehension of the meaning of these sounds, as a whole troop of riderless cavalry horses remained quite unmoved by the different bugle calls. On the other hand, however, the editor of *Thierfreund* relates the following story of his own personal experience of the sagacity of military horses:

In the year 1872, during a skirmish with the Sioux Indians, "the 3d Cavalry Regiment had formed an encampment in the valley of Niobrara, on the southern border of Dakota. At nightfall the horses were tethered by a long line to the ground. Toward daybreak a violent storm of rain and hail burst over the valley. The terrified animals broke loose from their fastening, and, in their fright, tore away up the steep sides of the valley into the territory of the enemy. Without horses, at the mercy of the enemy, we should be lost; yet it was impossible, in the half-darkness, to go after them into an unknown country, probably full of Indians. The captain, as a last resource, ordered the stable call to be sounded. In a few minutes every horse had returned to the encampment, and we were saved." The *Oesterreichischer Thierfreund* states that both horses and dogs have been proved to have good ears for music, particularly dogs, who have been known to whine piteously at certain passages, while at others they evince their delight and enjoyment by licking the performer's hand and begging him to repeat them. According to Aristotle, the flute is the favorite instrument of the horse. The Sybarites taught their horses to dance to the music of flutes. This accomplishment proved a serious drawback: for upon one occasion, when at war, and the inhabitants of the luxurious city were about to charge their enemy, their opponents remained stationary, each man producing a flute, and commencing to play upon it. The horses of the Sybarites at the accustomed sound immediately began to caper and dance in such a vigorous fashion that their owners lost all control over them, and were obliged to show the flag of truce. Another story, which is stated to be well authenticated, but which seems almost too good to be true, appeared a short time ago in a German newspaper.

A gentleman who was a finished musician resided some years ago at Darmstadt. He kept a dog, which was the terror of all the singers and instrumentalists in the place, for it had the fatal habit of raising its face to heaven and howling whenever a false note was emitted. It never made a mistake, and well-known singers were said to tremble when they saw their unwelcome judge, seated by his master's side, at concerts or at the opera, for "Max" was a regular first-nighter and a great friend of the theater director. He was never known to miss a new opera. "Max" was no respecter of persons, and when the singing was but a shade out, he would attract the attention of the whole audience to it with a terrific howl. One tenor went so far as to refuse to sing unless the dog was removed; but "Max" was so great a favorite with the Darmstadt public, and such a well-known frequenter, that the singer might as well have requested to have the director himself removed from the stalls, and he was obliged to give in with as good a grace as possible. The dog's master stated that he had trained him, when he was quite a puppy, by striking him hard when any one sang or played a wrong note; later on he tapped him gently; then he only had to look at him, and by the time he was three years old, the dog was as good a judge as his master of a false note.

A Great Armor Plate Bending Machine.

A few days since there was shipped from the Niles Tool Works, Hamilton, Ohio, a great armor plate bending machine for the United States Navy Yard at Mare Island, near San Francisco, Cal. The machine required eleven specially built and extra heavy flat cars, the two largest castings weighing respectively 66,400 and 66,200 pounds, and the gross weight of the train carrying the whole machine was 675,350 pounds. The entire distance to San Francisco, 3,400 miles, was to be run through without change, the machine to be taken thence forty miles by steamer to the yard. The freight was a little over $10,000

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MANUFACTURE OF PAPER ON THE CONTINENT.

When we refer to collections of journals of but forty or fifty years ago, we are much astonished to see before us sheets whose size rarely exceeds that of our present one cent papers. Moreover, the daily edition scarcely exceeded a few thousand copies. The great idea of the cheap press, it is true, had but just been put into practice by Emile de Girardin, and, although the paper machine invented by Louis Robert in 1799 had long permitted of dispensing with hand-made paper, it was far from having reached the capability of production that it now possesses. There was likewise a great revolution to be made in the selection of raw material. Rags, which until then had been exclusively employed in the manufacture of paper, had become both too scarce and too dear to allow their use to be continued as the sole supply for a demand that was increasing beyond all foreseen limits. It became necessary to restrict the use of them for the choicest and costliest papers, and for others to find raw materials which, while giving them the proper strength and grain, should permit of lowering their price to the exceptional figures at which we see them to-day. This is what constitutes the industry of rag substitutes, and which utilizes, with proper treatment, alfa, straw, and wood reduced to a pulp. All fibrous substances might be converted into paper, but the product obtained from them is usually too small to allow them to become the object of an industry, and it has become necessary, in practice, to make a choice of the substances just mentioned.

All these materials undergo successive preparations that we shall briefly describe, and then they pass into the paper machine, which is the principal agent of manufacture, and finally into accessory machines, such as calenders, cutting machines, etc.

The rags are first given into the hands of women, who cut them upon a knife placed in front of them upon a bench, and who separate from them such objects as hooks and eyes, buttons, and pieces of wool, silk, and leather, and then class the product of their work, or sorting, between twenty baskets, which go to the storeroom.

After this the rags are cut into smaller fragments and put in quantities of 2,200 pounds into a cylindrical vessel having a rotary motion and containing lime water. Heating is effected through the introduction of steam under a pressure of from 2 to 4 atmospheres. The lime removes the greasy matters and the steaming prepares the rags for their ultimate conversion into a pulp. At the end of a day the material is ready to pass to the stuff-engine. The present lime treatment replaces the rotting which was formerly done in vats, lasted from six to twenty days according to the nature of the rags, and was followed by a washing with water and a trituration in mortars by pestles covered with iron and actuated by a cam shaft.

In the stuff-engine (which is an oblong trough) there revolves a cylinder armed with blades and situated opposite a stationary piece, which also is provided with blades. The passage of the rags between the two apparatus reduces them to a pulp. The trough is separated in the direction of its long axis by a partition which permits of the circulation of the pulp. Opposite the cylinder there revolves, with a much slower motion, a drum covered with wire gauze, through which the dirty water escapes, while the meshes retain the pulp fibers. In addition, an arrangement at the bottom of the trough arrests all the heavy objects, such as buttons, etc., that have not been attacked by the alkali.

These engines are situated in the second story of the building, so that their product can pass by gravity to the first story into vats of the same form, containing a solution of chloride of lime, and called bleachers. The stirring of the mass is effected through a wheel with paddles. These vats are made of cement, while the others are frequently of metal.

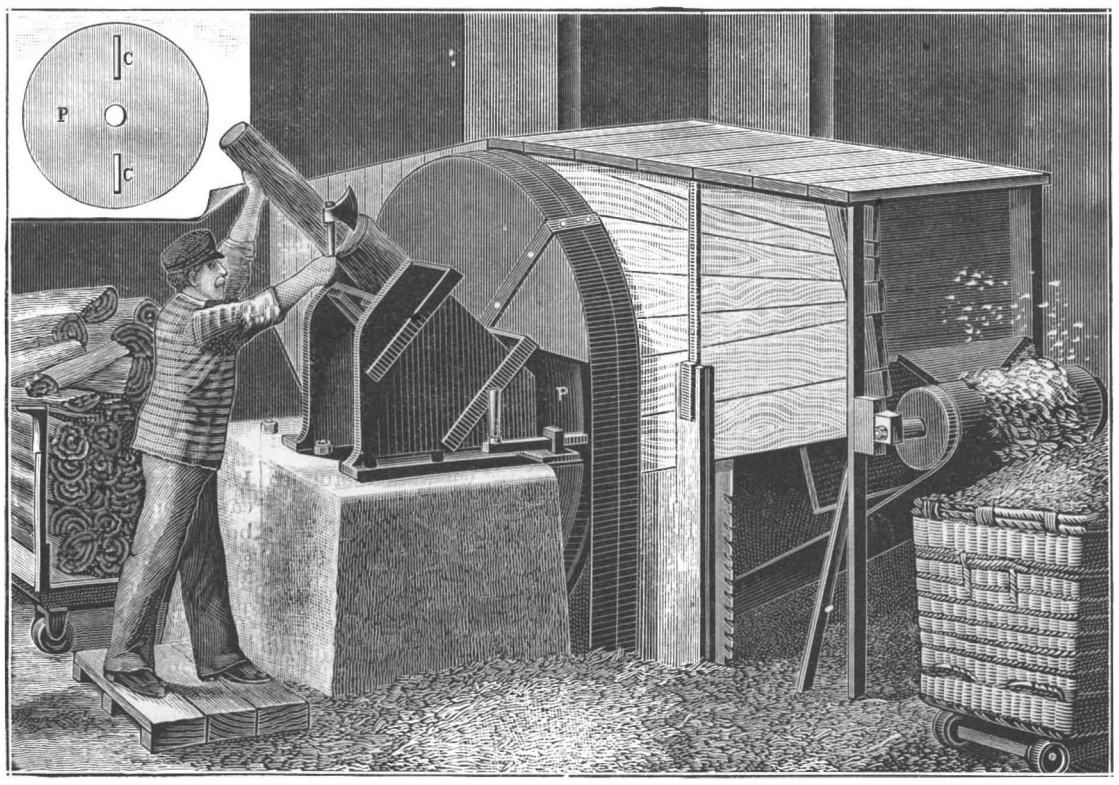

Fig. 1.—MACHINE FOR CUTTING WOOD IN THE MANUFACTURE OF CELLULOSE.

Alfa or esparte, which is especially employed in England, is carefully sorted and submitted to the action of soda instead of lime, at a pressure of four atmospheres. The operations of cutting and bleaching are the same as for rags.

The manufacture of straw pulp is much more general in France than that of alfa. All kinds of straw are used, and, as one gives just as good results as another, they are worked without distinction. After they have been cut by the chaff cutter, and then freed, by winnowing, of their spikes, knots, dust, etc., they are introduced into a lixiviating cylinder (either stationary or rotary) under a steam pressure of from 4 to 6 atmospheres. A six hours' treatment with steam suffices for a charge of 2,200 pounds. At the end of this time, the pulp is put into double-bottomed vats, where it drains and from whence the lye is extracted, to be converted again into caustic soda. If the pulp obtained is very good, it is washed with water in the same vats, and is then bleached in large basins under the action of chloride of lime. There is nothing further to do but to drain it in order to render it ready to be worked. The product in bleached pulp is about 40 per cent.

This manufacture can be remunerative only on condition that the soda is recovered from the lye. To this effect, the lye, as well as the first washing water, is evaporated in special furnaces (Porion's) which arrest the bad odors. The salts obtained are dissolved, and made caustic by lime. The latter, in turn, as a residuum of the operation, gives an excellent fertilizer. The revivification permits of recovering 80 per cent of the soda employed.

The woods that are used in the manufacture of paper are treated in two different ways, one mechanical and the other chemical. In the first, soft woods are especially employed, such as the aspen, poplar, etc., and in the second, the fir, and particularly the silver fir, which furnishes a very pure cellulose.

The mechanical pulp is obtained by abrading, on a horizontal grindstone, billets of wood 12 inches in length arranged in cells and held by clamps against the perimeter of the stone. A continuous current of water carries along the pulp formed, and which is further refined by another mill before it passes to the lixiviators. Norway, which, as well known, is widely covered with forests, furnishes Europe with a very large quantity of mechanical wood pulp.

The chemical pulp, which was formerly made by treating wood with caustic soda, is now almost universally obtained by the action of bisulphites, and particularly of bisulphite of lime. This process, which appears to have been first adapted to industrial practice by Dr. Mitscherlich, has received various improvements in Sweden, Austria, and France. It gives more economical results than soda, because of the much lower price of the bisulphite of lime.

The wood, which is in general that of the silver fir, is washed and decorticated, and then cut by a circular saw into billets 3 feet in length, and finally split by a machine. In this state, through the aid of an inclined box, it is presented to a mechanical cutter (Fig. 1), composed of a cast steel disk provided with two radial steel blades and revolving with great rapidity. This machine furnishes 35 cubic feet of wood shavings in the space of 6 minutes, and these shavings are thrown into baskets, whence they are afterward taken and spread upon wide tables provided with a grating through which the dust passes. The remains of knots or bark that would not be well adapted for treatment with alkali are carefully picked out by women. The shavings are then taken to the first story in baskets and put into the lixiviating apparatus. As the latter presents a few peculiarities because of the extremely corrosive action of the bisulphite of lime, we shall first speak of the manufacture of the bisulphite. This is obtained by the reaction of sulphurous acid produced either by the roasting of pyrites or by the burning of sulphur upon a column of lime stones. The gas traverses this column from bottom to top, and the reaction is facilitated by a showering with water in the opposite direction, and so regulated as to give a lixivium of a proper density. The bisulphite formed is collected at the base of the column. It is a colorless liquid, of an odor as suffocating as that of sulphurous acid, and attacks all the common metals except lead. So the iron plate lixiviating apparatus have to be provided with a lining of cement, upon which are laid several sheets of lead (Fig. 2). Besides, they are inclosed in masonry of refractory bricks, which are themselves covered with lead, and all the openings for the introduction or removal of the material are lined with the same metal.

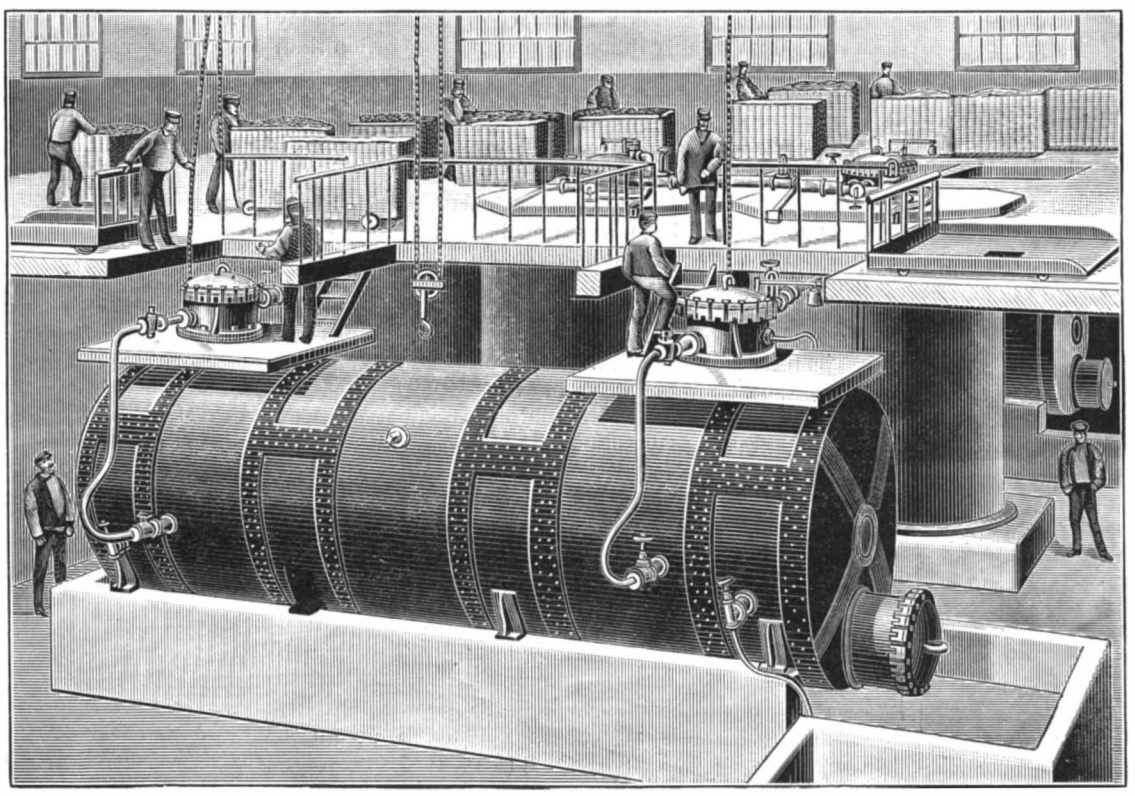

Fig. 2.—APPARATUS FOR TREATING CELLULOSE WITH BISULPHITE OF LIME.

These apparatus, which are of a very large capacity (1,400 to 1,800 cubic feet), are stationary or rotary. A worm made of an alloy of lead and antimony permits

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of the introduction of steam into the apparatus in order to raise the bisulphite to a temperature of 130°; but, as the steam might blacken certain parts of the pulp, it is introduced either through a double bottom or through lead worms with which the sides of the apparatus are provided.

The reagent removes the gummy and resinous substances, and these are retained in a residuum of sulphate of lime, while the cellulose remains in a practically pure state. In order to free it from the last traces of acid and resinous substances, it is washed with water, without any trouble being taken to collect the residua, which have no value. But the cellulose, which has preserved the appearance of wood, must be reduced to a finer pulp in order that it may be pumped to the purifying apparatus. So, on coming from the lixiviating apparatus it passes into large vats, where it is submitted to the action of an agitator that keeps it constantly in motion. From thence it is forced to the purifiers, which comprise the collectors (long wooden conduits, in which the heavy matters are deposited), and the sifters, which consist of boxes with a movable bottom provided with apertures that let the good pulp pass, and retain all else.

The pulp is finally drained in conical rotary sieves, and can then be directly employed for many papers, such as those on which journals are printed, colored papers, etc.

However, it has to be bleached by the mixtures designed for the finer papers. To this effect, there is now used a very ingenious process of electro-chemical bleaching, devised by Mr. E. Hermite. It consists in the decomposition of calcium or magnesium by the passage of an electric current. This forms a liquid possessing a most intense decolorizing power. In the presence of the vegetable fiber, the primitive salt is regenerated in measure as the bleaching proceeds, so that at the end of the operation the same bath can be used again. The sole loss of chloride is what the fiber has taken from the bath. The entire expense, then, is reduced to that occasioned by the production of the motive power necessary to actuate the dynamos, and the keeping of them in repair.

Finally, we may consider the waste of paper mills, or that of the industries that employ paper as a substitute for rags. Old papers are always sorted before being used. Those containing printed matter are first treated with soda before being refined, and then bleached with chlorine. They are afterward taken to granite millstones joined in pairs and running vertically over a third and horizontal stone inclosed in a cast iron vat, into which water is run while the waste is being thrown in. The same operation is applicable to the Norwegian mechanical pulp, in order to render it finer and more homogeneous.

The various pulps that we have just examined, being obtained either in the same mill or purchased outside, have to be mixed according to the qualities that it is desired to obtain. Delicate fibers, like those of cotton rags, yield a thin pulp and flexible and soft paper. Coarse and strong fibers, like those of hemp and flax, furnish a thick pulp and a transparent and smooth paper. Mechanical wood pulp, the fibers of which are very short, adds opacity and body, but quickly becomes yellow. Cellulose, which forms chemical wood pulp, furnishes an excellent paper, silky and soft to the touch and well adapted for printing. Straw pulp has shorter fibers than those of the preceding, but gives transparency and uniformity. Finally, alfa comes nearest to rags, and constitutes the substitute therefor *par excellence*.

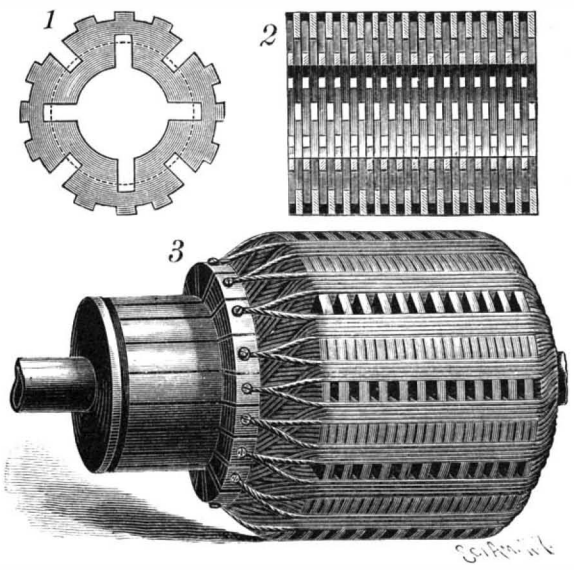
The mixture is made in beating engines, which are established in series of three. It is in these apparatus that the paper is sized in order to render it impermeable to ink. The sizing is done with a resinous soap, prepared by melting resin with carbonate of soda. The addition of a little alum to the vat precipitates a resinous compound of alumina, which agglutinates the fibers.

A weighting composed of kaolin, plaster, sulphate of baryta, etc., is used for common papers, of which it corrects the transparency and to which it gives whiteness. From 5 to 20 per cent of fécula is generally added to it, in order to fix it better to the fibers. Finally, the coloring, when pulps formed of colored rags are not used, which is most generally the case, is done by pouring the colors into the vat through a very fine sieve or through flannel. The invention of aniline colors, which are all soluble in water, has made this part of the manufacture easy; but these colors are unfortunately sensitive to the action of light.

The beating engines are in immediate communication with the large vats that form the head of the paper machine. We have now arrived at the end of the preparations, and in a succeeding article we shall touch upon the manufacture properly so called, either by hand or machine.—*La Nature.*

AN IMPROVED ARMATURE FOR ELECTRIC MACHINES.

The accompanying illustration represents an armature for electrical current generators or motors in



WRAY'S ARMATURE FOR ELECTRIC MACHINES.

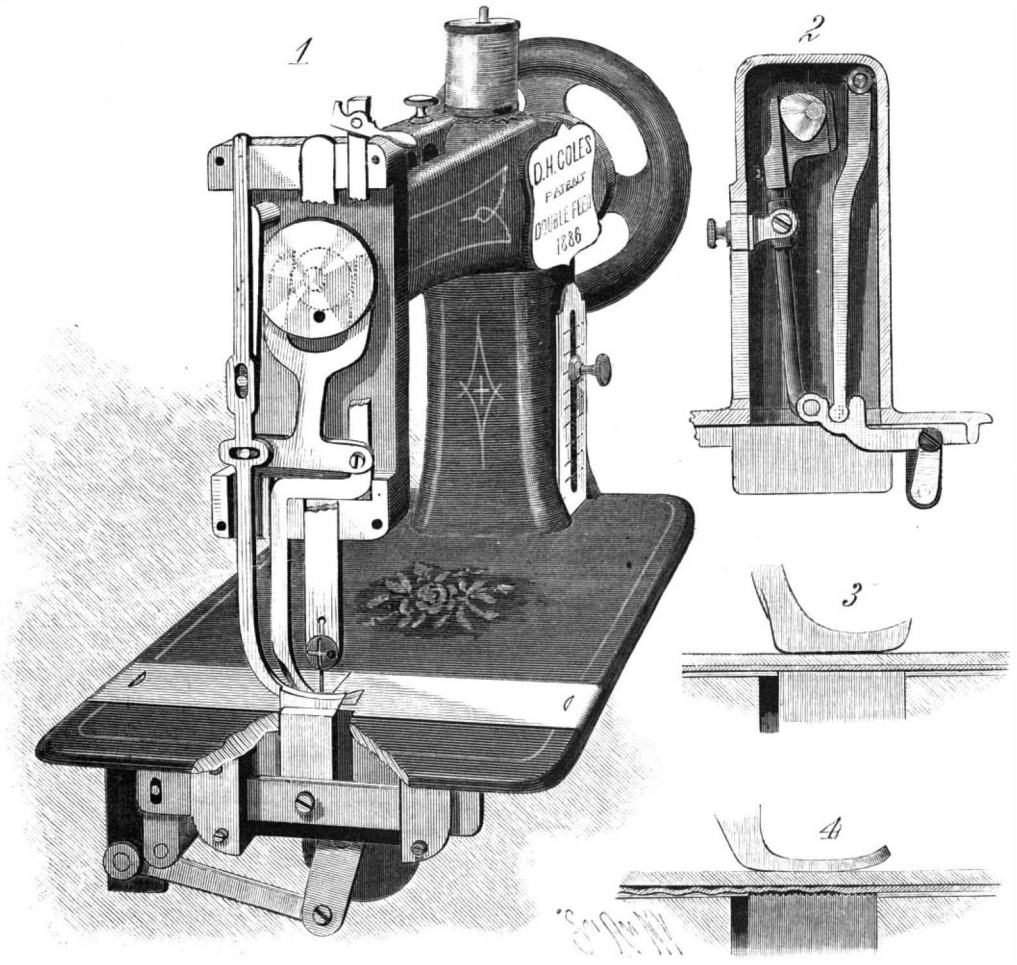
which the core of the armature is constructed of a series of annular plates of iron secured together in cylindrical form, to provide for the effective ventilation of the armature and thus prevent heating. Fig. 1 represents one form of such sheet metal rings so cut that the proper combination of a series of these rings will produce a laminated core having radial and longitudinal ventilating passages therein, Fig. 2 showing a longitudinal section of such an armature core, while Fig. 3 is a perspective view of such an armature when wound. The invention also provides for a slightly different construction of the armature ring by using two series of plates to be placed together alternately, the aligning edges of their radial slots forming continuous radial apertures and spaced longitudinal rectangular passages which will admit a current of cool air to the interior of the core, the notches in the periphery of each plate affording longitudinal grooves on the outer surface of the core for the winding of the armature.

This invention has been patented by Mr. John C. Wray (in care of Monarch Distilling Co.), Peoria Ill.

AN IMPROVED SEWING MACHINE.

The accompanying illustration represents a sewing machine having an improved feeding mechanism, patented by Mr. David H. Coles, of New York City, by which the material is clamped both top and bottom, and fed through the machine without any displacement whatever, no matter how the material may vary in thickness, or whether it be cut straight or curved.

Figure 1 is a perspective view of the machine, partly broken away to show the working parts. On the main shaft is a cam, shown in section in Figure 2, which engages with the upper end of an oscillating lever turning on an adjustable pivot, and connected by a link to an arm mounted on one end of a rocking shaft, the other end of which has an arm connected to the lower feed carrier. This carrier slides in bearings on the under side of the cloth plate through a slot in which the feed dog projects and acts on the under side of the fabric to be fed, the lower feed having only a horizontal motion. A rock shaft which serves to actuate the upper feed also receives its motion from the cam mounted on the main shaft, shown in Figure 2, whereby the oscillation of the upper feed dog necessarily corresponds with that of the lower one, the motion being preferably transmitted through the link which also moves the lower feed. The feeding surfaces of the feed dogs may be either roughened or left smooth, according to the nature of the work, which is always held either between the feed surfaces or between the presser foot and the cloth plate, each releasing the work as the other takes hold, whereby no unequal stretching takes place, and both surfaces of the work are fed evenly. To adjust the throw of the two feeds, or regulate the length of the stitch, a sleeve is carried by the adjustable pivot about which the lever engaged by the main shaft oscillates, this sleeve being pivoted in a carriage moving in a slot in the upright portion of the arm of the machine, where it may be adjusted by a set screw, as shown in Figures 1 and 2. The action of this double feed on the material being operated upon, as compared with that of the ordinary sewing machine, is illustrated in Figures 3 and 4, the former figure showing the material passed through smoothly, because clamped by both a top and bottom feed, while the latter exhibits the wrinkles in some cases almost unavoidably made by the material being pushed forward by a single feed, either under or top, against the fixed pressure on the other side. It is claimed that with this machine no basting is required, there being no displacement of the material as it is being sewed, while the feed automatically adjusts itself to any thickness of fabric, always lifting to just the height required without any lost motion, the object of the machine being to cover a range of work which it has been impossible to do heretofore in a satisfactory manner on any machine. For quilting, also, the machine is said to work as perfectly as a regular roller feed quilting machine, puffing the work in the most elegant manner, and working with the greatest speed.



THE COLES DOUBLE-FEED SEWING MACHINE.

For further information relative to this machine, address the Manhattan Quilting and Manufacturing Co., room 200, No. 45 Broadway, New York City.

British Refrigerating Ships.

Our food supply has been largely increased by the application of apparatus for mechanical refrigeration to ships. Our frozen meat trade with New Zealand is of recent development, and it has already reached enormous proportions. At present twenty-seven steamers and ten sailing vessels, all fitted with mechanical refrigeration machinery, are engaged in this trade. The aggregate tonnage of these twenty-seven steamers is 123,000 tons, or an average tonnage of about 4,500 tons, while that of the sailing ships is 10,000 tons, or an average of 1,000 tons each. It will thus be seen that thirty-seven vessels are engaged in this trade, of 133,000 tons total carrying capacity. The total frozen meat cargo which these vessels can carry in a single year amounts to the enormous number of 2,250,000 carcasses, which certainly gives some idea of the great importance of this trade. It is estimated that not more than 1,500,000 carcasses will be available for the trade this year, so that the carrying capacity is more than sufficient for the present volume of trade.—*Steamship.*

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LAUNCH OF THE UNITED STATES STEEL CRUISER NEWARK.

Just after noon on the 19th inst., while snow was falling fast, the new 4,000 ton U. S. steel cruiser Newark was launched from the shipyards of Messrs. William Cramp & Sons, Philadelphia, as shown in our first page illustration. There was present a distinguished company, Rear-Admiral Jouett representing the Secretary of the Navy, and from the Navy Department were four of the bureau chiefs, Commodore Farquhar, of the Bureau of Yards and Docks, Theodore D. Wilson, of the Bureau of Construction and Repair, George W. Melville, of the Bureau of Steam Engineering, and John M. Browne, of the Bureau of Medicine and Surgery. It is estimated that notwithstanding the uncomfortable weather there were six thousand people present, and at the collation given following the launch there were fully five hundred in attendance, including a large number of officials and prominent citizens from all sections of the country.

In addition to platforms built beyond the sides of the vessel, a special platform was erected around the bows for the christening party and the principal guests, and the beak of the great metal ram projected right up among those gathered at this point. At 12:30 P. M. the last supports which had held the ship in place were knocked out, and as she started off the ways she was christened by Miss Boutelle, daughter of the chairman of the Naval Committee of the House of Representatives. The launch was in every way successful, the headway of the vessel being checked in about 200 yards, when she was slowly towed back to the dock.

Especial interest attaches to the Newark from the fact that she is essentially an American ship in design, material, and construction, whereas several of the other new cruisers have been largely built after plans furnished by foreign engineers, and are, to some extent, copies of existing vessels in the English navy, although with material modifications. The Newark is a twin-screw unarmored vessel, having a poop and forecastle deck, with an open gun deck between. She is built of mild steel throughout, and has a steel deck extending her whole length, below which are the engines, boilers, magazines, shell room, torpedo spaces, and steering gear. The engines and boilers are further protected by coal bunkers, which serve as extra armor as well as fuel stores. The engines are designed, with natural draught, to afford 6,000 horse power, to be increased with forced draught to 8,500 horse power and to give a maximum speed calculated at 18 knots per hour. The following are the principal dimensions of vessel:

Length over all	328 feet.
Length on the load water line	310 "
Moulded breadth	49 "
Extreme breadth	49·14 "
Depth (knee plates to spar deck)	31·80 "
Mean draught of water	18·825 "
Displacement in tons to load water line	4,082·93
Tons per inch at load water line	24·96
Area of load water plane	10,484 sq. ft.
Area of immersed mid-ship section	807·23 " "

The Newark has a double bottom for 127 feet, covering the space occupied by the engines and boilers, the depth between the inner and outer skin plating being about 39 inches, and this space being divided into 12 watertight compartments by means of solid floors and a vertical keel. The engine and boiler space is divided into 17 watertight compartments, while the space between the engine and berth decks is divided into 72 watertight compartments. On the berth deck are 7 watertight compartments, and all the openings from this deck to the engine and boiler rooms are protected by coffer-dams, while the scuttles, hatches, and storerooms are watertight. Below the gun deck, when all the watertight doors are closed, there are 147 distinct compartments, and there are 85 such compartments when the doors are all open.

The protective deck, for 168 feet of its length, rises to fifteen inches above the load water line, while forward it slopes to 4½ feet below the water line, to strengthen the stem, and abaft it slopes to 3 feet below the water line. The horizontal portion of this deck is about 2 inches thick, which is increased to 3½ inches over the steering gear, while the sides are about 3 inches thick, the angle of inclination being designed to prevent a projectile from striking a straight blow upon it. Armor shutters and scuttles of the same thickness as the deck are fitted at all hatchways and openings, and these are also inclined to deflect projectiles. The coal armor belt is about nine feet thick amidship, and seven feet forward and aft.

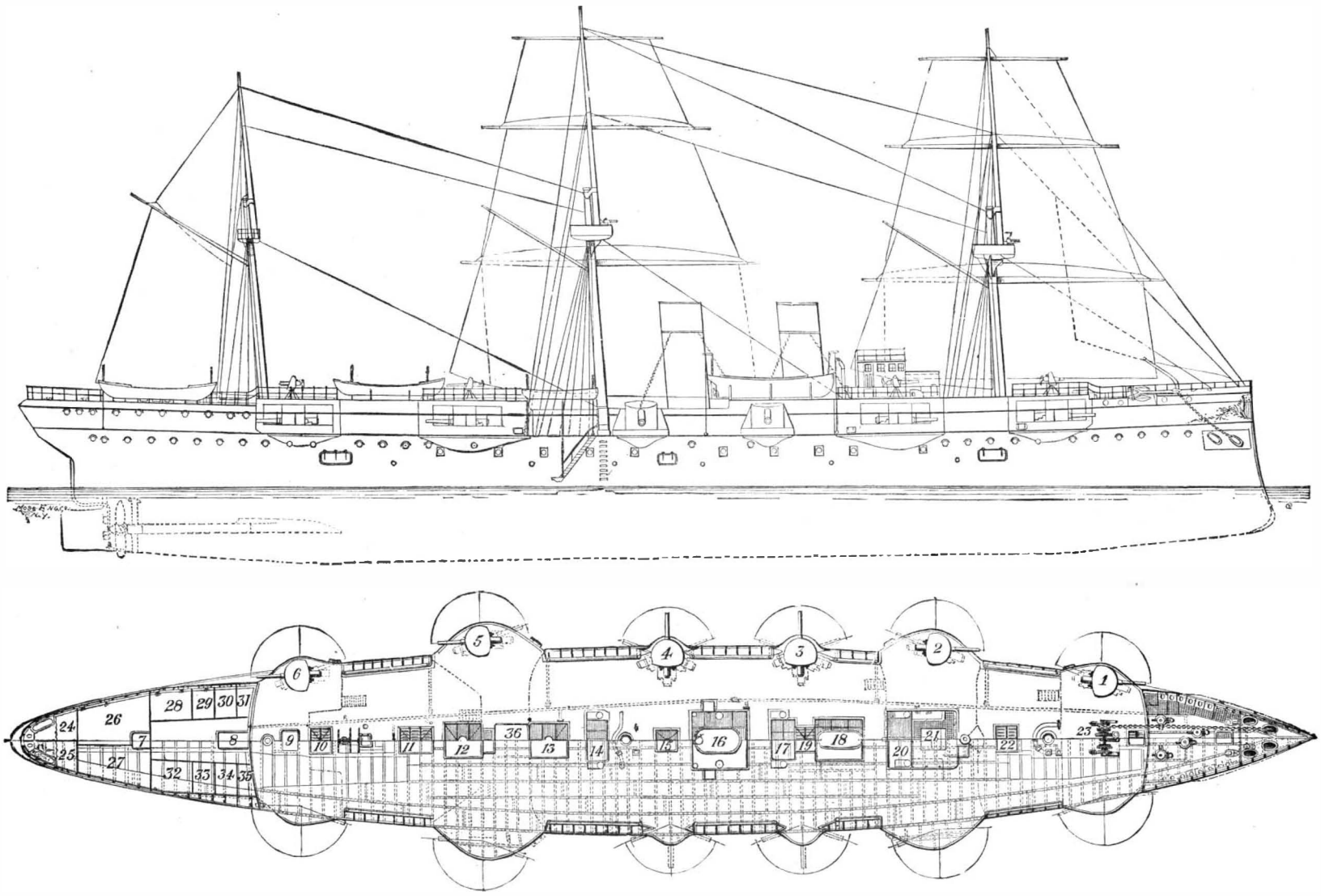
The main battery of the Newark consists of ten six-inch breech-loading rifles, each using a 100 pound shell with a powder charge of fifty pounds, the projectile being designed to pierce thirteen inches of iron at its muzzle velocity. The guns are mounted on central pivot carriages, with circular shields fitted to each to protect the gunners from the fire of machine guns. The two forward guns, one on each side, are trained from 70 degrees abaft the beam to 95 degrees forward, giving a cross fire of five degrees at 111 feet forward of the stem. The two after guns have nearly the same range of fire, and all of the battery on one side can be concentrated on an object not more than thirty feet away.

The secondary battery consists of four six-pounders, four Hotchkiss revolving cannon, and two short Gatlings, while there will be other Gatlings in the fore and aft tops. The vessel will also have six torpedo-launching tubes worked from the berth deck. The ram-shaped bow of the Newark, as compared with that of the Philadelphia, is shown in one of the views on the first page. It is thoroughly stiffened and strengthened by bulkheads and breasthooks for ramming purposes.

The boilers and machinery of the Newark are said to be all ready to be put in, the power to be furnished by two triple expansion engines with cylinders of 34, 48, and 76 inches diameter and 40 inch stroke. There are four boilers, each 13½ feet in diameter and 19½ feet long, designed for a steam pressure of 160 pounds to the square inch, and with a grate surface of 540 square feet. Sail is to be used only as an auxiliary for cruising purposes, but a spread of 11,932 feet of canvas is provided for.

The incandescent system of electric lighting is to be adopted throughout the vessel, which will also be supplied with electric search lights. The ventilation will be effected by the exhaust system, which is said to have been found very efficient in the navy.

The Newark is the final one of five government war ships built by William Cramp & Sons, the other four having been the Vesuvius, Yorktown, Baltimore, and Philadelphia. In size and general dimensions the Newark greatly resembles the Baltimore, although her lines are quite different. It will probably be autumn before this last vessel will be furnished with her machinery and fittings and be ready for trial. She is intended for use as a flagship, and the space under her poop will be made into quarters for the admiral and captain. She will have a crew of about 300 men.



UNITED STATES STEEL CRUISER NEWARK—SIDE VIEW AND PLAN OF GUN DECK.

A New Plan for Rapid Transit in New York.

A plan for the solution of the rapid transit problem in this city has been formulated, and presents a very striking and original aspect. It originated with the late Mr. D. C. Lindsey, C.E. It contemplates the erection of a structure which will carry a four-track railroad. This structure is to be of masonry, and to be about 60 feet high. It is to be carried through the center of blocks, and the streets are to be bridged by steel bridges. By making the substructure heavy enough it will be available for stores and tenements. The route is to extend north just through Tarrytown. It is to form a loop in the southern part of the city from Leonard Street south. The only public property touched is a small corner of Battery Park. To carry out the plan, "The People's Rapid Transit Company" has been organized. The principal features of merit of the plan are the capacity for high speed, the avoiding of any but the most limited trespass upon streets or private grounds, and the fact that it is an overground way. It is estimated that the acquisition of real estate will cost over $70,000,000. The entire cost is estimated at nearly $90,000,000.

The Ascent of Mount Kilima Njaro.

A German expedition, under the direction of Dr. Meyer, has succeeded in reaching the top of this marvelous peak of Central Africa, which stands only three degrees south of the equator. The expedition was working for sixteen days at a height of over 13,000 feet, making four ascents to the Kibo summit and three to the Mawenzi summit. Here, surrounded with perpetual ice, they found the crater of the great Kibo mountain, having a diameter of about 6,500 feet and a depth of about 650 feet. The aneroid gave the height of the highest peak as 19,690 feet.

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RECENTLY PATENTED INVENTIONS.

Engineering.

BOILER TUBE SCRAPER. — John B. Christoffel, New York City. This scraper consists of a series of spirally arranged spring blades with serrated edges, adapted to be easily and quickly contracted or expended to fit various sized tubes, and readily cut the hard crust usually formed in water and steam tubes, the invention being an improvement on a former patented invention of the same inventor.

BOILER SETTING.—Daniel King, Finksburg, Md. This invention provides for an arched combustion chamber with a bridge wall in the rear of which is a chamber, there being a boiler space above the arch and chamber, and another chamber extending from the front end of the boiler space down in front of and under the combustion chamber, for effecting thorough combustion of the fuel gases mixed with air and steam when necessary in a highly heated reverberatory furnace before contact with the boiler surface.

Railway Appliances.

CAR COUPLING. — George F. Harlan, Leeds, Md. In this coupling the coupling bar has an arrowhead at one end and at its opposite end an opening for the securing pin, while the drawhead has guide openings for the coupling pin, there being spring plates on the opposite sides of the openings to direct the arrowhead into engagement with the coupling pin held in the guides.

Mechanical.

BIT CHUCK. — John W. Miller, Mount Sterling, Ky. This chuck has a longitudinally slotted body, jaws with tapering outer faces pivoted in the slot and a spring normally holding the jaws apart, while a spring surrounds the body and jaws and a sleeve fits over them, whereby the chuck is capable of instantly and securely fastening and adjusting itself to any sized bit.

NUT LOCK. — Aaron C. Vaughan, Shane's Crossing, Ohio. This lock consists of a plate adapted to be applied to the bolt outside the nut, the plate having a bolt hole with oppositely threaded sections between which the metal is cut away, and having upturned wings lying tangential to the threaded parts of the bolt hole, and also threaded on their sides, the wings serving to pinch the bolt and lock the nut thereon by spring action.

PUNCHING MACHINE. — George F. Breuer, Humeston, Iowa. This is an attachment for anvils comprising a pivoted standard with an aperture to receive a punch, a clamping device for securing the standard to the anvil, and a bed plate adapted to fit on the anvil, being designed for use in connection with hot or cold iron, and arranged to be adjusted so that the parts will not interfere with the use of the anvil for ordinary purposes.

Miscellaneous.

POTATO PEELER. — George B. Haines, New York City. This device consists of a segmental curved plate having its upward bent end provided with a series of transverse openings, and with knife blades on its under side at the openings, one of the knives being on the lower edge of the bent-up end of the plate, the tool being specially adapted for rapidly and conveniently peeling apples, potatoes, and like vegetables and fruits.

SHAVING AND DRESSING STAND. — Mary E. Greene, New York City. This invention provides for standards supporting a mirror and a box for the reception of the shaving utensils, with legs pivoted on the standards and pivotally connected with a table hinged thereon, the stand being easily folded up when not in use and affording space for conveniently storing the shaving utensils.

CURTAIN FIXTURE. — Frederick Spitz, New York City. This invention provides for a curtain pole ring having an inward projecting angled bend, and a friction roller through which one arm of the bend passes, whereby the curtain will be held close to the pole, and at the same time permitting an easy sliding of the curtain whenever desired.

SEWING MACHINE GUIDE. — Alice La Guayra Mayo, New York City. This is a standard for attachment to the presser bar, with a gauge bar having a longitudinal opening held to slide upon one face of the standard, while arms projecting downward and outward at an angle to the ends of the bar are provided with upwardly curved outer extremities, the device being adapted for use either as a right or left hand gauge without being detached from the machine.

FLASH TORCH. — William L. Heiskell, Indianapolis, Ind., and Francis E. Drake, Columbus, Ohio. This is a device adapted for use in connection with theatricals, etc., having detachably united casing sections, and a valved air bulb connected with a powder magazine upon which is supported a lamp, the powder conduit from the magazine to the lamp being straight and direct, insuring effective operation at all times.

EASEL. — George L. Hann, Beverly, Ohio. This invention provides a simple construction and arrangement of parts for an easel which may be folded compactly when not in use, and may be secured by a single latch or fastening.

FOLDING DOOR. — Albert Neyand Joseph Baumgartner, Dubuque, Iowa. This invention relates to doors supported on hangers attached to the inner edge of the door and to the door frame, permitting the door to be moved without contact with either the floor or the cap of the frame, there being combined with the door and its frame hangers attached to pivots fixed to the door and to a bracket upon the door frame.

HEATING STOVE. — Salathiel C. Fancher, Kansas City, Mo. This is designed to be a simple and non-explosive oil-burning stove, easy to manage and adapted for quick and thorough regulation of heat, the supply of oil being readily lessened or cut off from the vapor generator, while there will be no liability to sooty clogging in working the stove.

SKIRT PROTECTOR. — Malcolm H. Smith, New York City. A water proof outer skirt is made with a continuous tape around its upper edge, there being an extension below the tape on which is a series of fabric grasping or clamping clips to grasp the free portion of the tape, or the fabric of the underskirt, and thus inclose the bottom of the skirt.

BOLT. — David Austermuhl, Jr., Cramer's Hill, N. J. This is an automatic locking device for sliding door bolts, embodied in the form of a lever hook or catch pivoted to the bolt and adapted to pass through and engage with a bolt keeper, or the catch may be made to engage any other fixed projection instead of the keeper.

FURNITURE DRAWER. — Elijah F. Waller, Hanson, Ky. This invention affords an improvement in tilting drawers, the frame receiving the drawer having a cross bar at its rear on which the drawer rests when closed, and the drawer having depending legs at the front pivotally supported by the frame, the drawer opening in such a way that articles cannot be caught to interfere with its movement.

WATER CLOSET.—Charles R. Schmidt, Baltimore, Md. This closet has an all-porcelain hopper and trap, with flushing rim and a special passage to the bottom of the hopper and a bent discharge outlet, forming a siphon above the level of the floor, whereby both suction and force are used for emptying the hopper, which normally stands filled with water taken from a tank four or five feet above the level of the closet.

ROAD CART. — Patrick W. Fergus, Mineola, N. Y. In this cart the body springs have a rocking bearing on the axle, combined with longitudinally ranging keepers on the shaft and pins on the body entering the keepers, and having backward and forward play therein, for the purpose of reducing "horse motion" to a minimum.

WAGON BODY. — Benjamin F. Short, Buena Vista, Ga. This body is made in two parts, so that the upper one may be easily lifted from the lower, each part having its ends provided with horizontally swinging end boards at each end, whereby the wagon may be easily adapted to carry small truck or heavier articles.

BARREL TRUCK AND JACK.—James H. Stansbury, Lawrence, and Isaac U. Hyatt, Jamaica, N. Y. This is a simple and durable truck for barrels containing oils or other merchandise to be drawn off or retailed from the original packages, by using which the labor of handling and placing the barrel in convenient position may be materially lessened, allowing one man to easily do what would ordinarily require the work of two men.

BURGLAR ALARM.—Julius Vogel, New York City. This is an alarm for windows or doors in which a detonating cap is exploded when the door is opened or the window raised or lowered, the casing or shell being fastened in an inclined position to the door or window casing, and the apparatus tripped when the door is opened.

TOBACCO PIPE.—Charles D. Weldon, Mica, Washington. The stem of this pipe is made in sections, and has a recess on its under side to receive a cleaner provided with a ring fitted to the joint between the sections of the stem, whereby the cleaner will be always at hand and in no way disfigures the appearance of the pipe.

PAPER BOTTLE.—Hubbard F. Bannard, Nashville, Tenn. This is a conical bottle having its bottom formed with an annular groove, and having a tubular nozzle, making a strong, cheap, and durable bottle, and one not easily tipped over, especially adapted to hold ink and mucilage.

WATER TROUGH FOR CATTLE CARS. —Ferdinand E. Canda, New York City. According to this invention, a series of troughs or buckets are arranged on either side of the car, the buckets being hinged to a supporting rod having inwardly extending arms to engage them, whereby the buckets may be turned up singly or collectively by means of a crank arm and connections.

BUTTER CRATE.—William H. Ferguson, Seattle, Washington. This is a cylindrical crate with closed sides and bottom, and a top adapted when placed in position to effectually exclude air from the interior, the inner surface of the crate body having an annular recess into which the top closely fits, while the inner surface of the crate also has longitudinal grooves extending from the top to the bottom.

BAGASSE DRIER. — Manuel Espinosa, Matanzas, Cuba. A casing within a housing is provided with an endless traveling carrier, flues extending through the casing in connection with barriers or deflectors for imparting a tortuous or serpentine draught, the heat being delivered above and below an advancing stratum of bagasse, provision for agitating which is made and for carrying off the vapor produced.

OIL CAN.—Jean M. N. Jay, New York City. This can is so constructed that the spout may be manipulated to permit the liquid to flow or to cut off the supply, means being also provided whereby any extraneous matter in the vessel with the oil will be effectually prevented from passing out with the oil.

BLIND STILE BORING MACHINE.—William C. and John A. Aycock, Griffin, Ga. In this machine a mounted sliding frame carries the bits, markers to which levers are connected engaging the stile, while pins held on the frame are adapted to actuate the levers on the up and down motion of the frame, with other novel features, the machine rapidly boring the aperture and automatically marking the mortises.

YARN NIPPER FOR SPINNING MACHINES.—Louis Wimmer, Elizabeth, N. J. This is a device for use in the manufacture of yarns or cordage, the nipper having several novel features designed, in connection with a suitable fiber or sliver feeder and a twisting device, to produce a compactly and smoothly twisted yarn or cord with economy of time and labor.

ANCHOR ALARM AND TIDE TELL-TALE. —James W. Jones, New York City. This is an alarm connected with a rope or chain arranged to be held to the bottom in case the vessel is anchored, or to a wharf in case the vessel is moored, to give an alarm should the anchor drag or the moorings give way, or to sound an alarm at the moment of the change of tide.

APPARATUS FOR ICE MANUFACTURE. —James W. Brook, Lynchburg, Va. This is a frame inclosed in a house of suitable construction, by which may be supported ice cores or posts formed of sections or blocks of ice one on the other, with troughs to discharge water thereon, whereby ice may be frozen in position in cold weather, and then inclosed as desired in warm intervals, to prevent thawing, thus affording a means of obtaining a commercial supply for use in the summer season.

MOULD FOR ICE BLOCKS.—This is another patented invention of the above inventor for a mould for forming the blocks or sections to be united to form the ice posts or cores to which water is applied as above described, the main portion of the mould being preferably formed of thin metal into a tapered expansible body piece readily freed from the ice block or section which may be frozen therein.

MOTOR SLED.—Calvin Jackson, Jacksonwald, Pa. This is a sled with runners and a bicycle frame, in connection with a pair of lazy tongs having pusher legs to be operated by the rider's feet, its two runners assuming the place of tandem wheels, a steering device being connected to the front runner, and it being designed for use by both sexes.

GAUGING ROD. — Arthur M. Hill, St. Stephen, New Brunswick, Canada. This is a graduated rod having a dart pivoted thereto provided with a straight edge and a slightly curved edge at nearly right angles to the straight edge, to better measure the contents of kegs and casks by allowing for the slot or recess at the intersection of the head and stave.

ANT TRAP. — Joseph L. Stillman, Fresno, Cal. This is a device to be attached to the legs or base of the table, refrigerator, or other article to be protected, and has at its bottom a socket for a caster or roller, above which is a circular water trough, the device being applicable to receptacles which have either legs or flat bottoms.

SCIENTIFIC AMERICAN BUILDING EDITION.

MARCH NUMBER.—(No. 53.)

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18. Design for a Congregational church of moderate cost.
19. Miscellaneous Contents: Errors in architectural design. — Sandy foundations.—The "Auditorium," Chicago.—Improved interior finish.—Adobe houses in Louisiana. — Drives and walks.—To take grease from marble.—Hydraulic passenger elevators, illustrated.—Slow burning buildings.—Hill's solid steel anvil, illustrated.—Sliding door blinds.—Improved wood working machinery, illustrated.—Barlow's shipping tags.—To estimate brick work.—An automatic pump operated by water pressure, illustrated.—Increased use of water filtering appliances.

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To Manufacturers Electrical Machinery, etc.—Please forward catalogues to W. Crawford, Mount Eden, Auckland, New Zealand.

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The locomotive "Onward," illustrated in Scientific American of March 8, is drawing the Philadelphia express on the Central R.R. of N. J., daily. For full information respecting this locomotive address C. E. Swinerton, president, at Fifth Avenue Hotel, New York.

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NEW BOOKS AND PUBLICATIONS.

PAYNE'S BUSINESS EDUCATOR. By F. M. Payne. New York: Excelsior Publishing House. Pp. 596. Price $2.

This work comprises an epitome of Federal and State law, and a vast amount of useful information in the way of commercial laws, forms, and requirements are contained within its covers. The ground covered by it is varied, including commercial letter writing, commercial forms and tables, parliamentary law, lessons in typewriting and penmanship, and finally laws, together with forms for practical use, the latter of almost every conceivable form that may arise in everyday life. A dictionary of synonyms is a useful addition. This is placed at the end of the volume, and fills nearly fifty pages. The work is one of very general usefulness, and will be acceptable to a very large clientage of readers.

THE LEGAL ADVISER. By F. M. Payne. New York: Excelsior Publishing House. Pp. 317. Price $1.50.

In this work we have included a portion of the one just noticed. The subjects are alphabetically arranged, running from "Acknowledgment" to "Warranty," "Water Course," and "Will." Some of the specially important topics treated are assignments, mortgages, deeds, interest, landlord and tenant, promissory notes, trademarks, copyrights, etc., etc. For those not wanting the larger work, this supplies the more generally useful portion.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Mineral sent for examination should be distinctly marked or labeled.

(2019) J. L. D. asks: How can we make a small quantity of gas that shall have a large percentage of sulphureted hydrogen or ammonia? A. Pour dilute sulphuric acid upon sulphide of iron, to produce sulphureted hydrogen. Use care, as it is poisonous. For ammonia expose aqua ammonia to the air or gently heat it in a retort.

(2020) C. F. H. asks: 1. What would be the effect upon a bottle of water securely corked and submerged in alcohol or mercury at a temperature of 50° below zero? A. The water would become ice. 2. Would a piece of flesh freeze, if placed in the alcohol at the same temperature? A. Yes.

(2021) H. C., Egypt.—I wish that you could advise me through your columns what is the proper speed to run a Broadwoods helved hammer, as I have just got one and wish to know what speed it requires to run at. A. We have no information as to the size of the helved hammer. Their speeds should vary with their size and the kind of work. A small hammer, 80 to 120 strokes per minute. Large ones, with 5 or 6 foot arm, from 45 to 70 strokes per minute, according to the nature of the work.

(2022) W. T. K. asks: How to keep lemon juice without spoiling? A. Keep in a tightly corked bottle. One or two grains to the gallon of salicylic acid may tend to retard fermentation, but the use of extraneous preservatives is not to be recommended.

(2023) C. F. H. writes: 1. I have some drawing models in relief, in paper; will you kindly give me some receipt for applying some liquid to the surface to restore the white appearance? I have tried whiting, but it rubs off. A. Canada balsam, or even gum water, may be mixed with whiting and applied as paint. 2. Is there any way to remove superfluous hair from the face without injury to the skin? A. It can be done by electrolysis. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 176 and 353.

(2024) C. R. D. writes: I have been making a mercurial barometer, and find difficulty in expelling air and moisture. Have succeeded fairly well by placing the tube filled with mercury in boiling water. Would like to know how to build furnace, in order to boil the mercury in the barometer tube. A. Use an alcohol lamp. If your tube is of small caliber, you may succeed in boiling the mercury, but you run much risk of breaking the tube. There should be no trouble from moisture. If the tube contains any, you will be almost certain to break it in the boiling operation. Conduct the latter operation over a large china basin to catch the mercury in case of fracture.

(2025) C. F. J. asks: What substance would be readily soluble in sea water, and not at all affected by the heavy oils? A. Any number of salts, such as chloride of sodium, chloride of calcium, sulphate of soda (Glauber's salt), etc.

(2026) D. E. W. writes: 1. I have just purchased an Edison low volt 4 candle incandescent lamp, and have been trying to light it with a battery consisting of 3 cells, each containing 1 zinc and 2 carbon plates, each 2×6 inches, using a bichromate solution, but do not succeed. The battery will readily heat an inch of platinum wire red hot. Is this battery too small? If so, please tell me how many cells to add. A. Your battery is too small. Six cells may operate the lamp, but it is probable that eight will be required. 2. Can you tell me a simple way of connecting an electric bell with short line of telegraph, using the same wire and batteries? A. See SCIENTIFIC AMERICAN, current volume, page 123. 3. What size wire do I want to use to connect up an incandescent lamp with a battery? A. For a short distance No. 18 will answer. 4. How shall I connect my battery (in series or parallel) to light an Edison 4 candle power low volt lamp? A. Series. 5. What is the amperage and internal resistance of a bichromate battery? A. Resistance varies from ½ ohm per cell upward. The E. M. F. is 2 volts. According to Ohm's law $\frac{E}{R}=C$ in amperes. E=2, R=0·5, therefore $\frac{2}{0{\cdot}5}=4$ amperes. When any external resistance is included, the result will be different. 6. Is bichromate of soda as strong as bichromate potash when used in a battery? A. Yes. 7. Will you please explain the following terms: Ampere, volt, electro-motive force, watt, internal and external resistance, ohm? A. You should study some elementary work on electricity to learn the meaning of these terms. You will find them in almost any modern work on electricity or physics. 8. How fast can I decompose water with a battery of three cells, zinc and carbons 2×6 inches, bichromate solution? A. So as to form about 100 cubic centimeters of mixed gases per minute. 9. Can I make a storage battery out of sheet lead (such as can be bought at a hardware store), roughening the surface and coating it with red lead, and placing the whole in a quart or gallon jar with dilute sulphuric acid? A. Yes. 10. Can I light the 4 candle power incandescent light (low volt) with the storage battery mentioned above? If so, will the quart size do? How long will it take to charge it? A. It will require from 3 to 4 cells. The size mentioned will do. It requires from 7 to 10 hours' charging.

(2027) W. P. R. writes: 1. I saw a receipt for removing superfluous hair, viz., a strong solution of barium sulphide made into paste with powdered starch. Now what fluid is used to make it into paste? A. Water. 2. A receipt for making a good brown ink. A. Use an aniline brown of the desired shade dissolved in water with enough gum arabic solution added to make it flow well from the pen. 3. A receipt for removing yellow spots from marble. Several formulas have been devised. Generally a mixture of softsoap or alkali with whiting or equivalent is applied and left on for some hours. One reads as follows: Washing soda 2 parts, pumice stone ground 1 part, finely powdered chalk 1 part, mix to a paste with water. Rub over marble and wash off with soap and water. To remove stains a mixture of 1 ounce ox gall, 1 gill of lye, and 1½ tablespoonfuls of turpentine made into a paste with pipe clay is left upon the stain for several days. Common clay saturated with benzine may be used to absorb grease. In all cases allow the mixture to remain some time upon the marble. 4. Is benzine used to clean grease from clothing? A. Yes. We cannot undertake to give formulas of proprietary medicines.

(2028) J. M. T. asks: 1. Will the law require me to take out a license for the selling of an article for which I have applied for letters patent, but patent not yet allowed? A. No. 2. Can you give me a recipe for making the gold and silver ink such as is used in the crown lining of hats for trade marks? Also tell how to use it and what kind of type to use? A. Use true gold, Dutch gold, or silver leaf. Dust some powdered glair (dried egg albumen) over the surface, lay on the leaf, and print the design by pressing on hot brass or other metal types. Or use bronze powders mixed with japan drier and boiled linseed oil and applied by a metal or rubber stamp.

(2029) W. H. L. asks: Why does the paint on some buildings crack and peel off, and is there any known preventive? A. Outsides of buildings that have been many times painted will blister and peel under the heat of the sun, which generates a vapor or gas on the inner surface of the new paint; the old paint being weathered and partly decomposed, easily parts from the new coat. In a few cases the surface of the wood beneath the paint separates from the paint by difference in expansion caused by great changes in temperature and a poor priming coat. It can be prevented when the first or priming coat is an oil paint and the wood dry. Green wood is also a cause of blistering.

(2030) M. A. X. asks: What indicated horse power has a plain 10×12 slide valve engine cutting off at ⅝, running 250 revolutions, under 80 pounds boiler pressure, feed pipe well protected with asbestos? What is actual horse power? Please give simple and plain directions for calculating about the actual horse power of an engine. A. Your engine will indicate 86 horse power. Its actual horse power will be its indicated horse power less its friction, which may range from 5 to 8 per cent, say about 80 horse power. The computation is: multiply the square of the diameter of the piston by 0·7854, and this product by the mean pressure due to the cut-off, and this product by the piston speed in feet per minute. Divide the last product by 33,000 for the indicated horse power. The pressure due to cut-off in your statement is 92½ per cent of the boiler pressure, and for all other points of cut-off is tabulated in Haswell's "Engineer's Pocket Book," which should be in the hands of every engineer. We mail it for the price, $4. The computation of mean pressure requires the use of logarithms, while the tables afford a ready reference.

(2031) J. G. writes: 1. Will dry plates that have been spoiled by light do to make photo. reliefs? Can spoiled plates be used in any way? A. Spoiled or "light struck" dry plates are useless. 2. I have a lot of old copper plates that have been used to amalgamate gold in a quartz mill; now is there any way I can separate the gold from the copper? A. We know of no way of economically separating gold as you specify. The plates could be dissolved in nitric acid or could be oxidized by igniting in a proper furnace, and then the solution effected in sulphuric acid. The latter is cheaper.

(2032) A. W. E. asks: 1. How many feet to the ohm of commercial copper wire No. 36, of No. 24 German silver wire? A. Copper No. 36, 2·32 feet to the ohm. German silver No. 24, 2·9 feet (approximately). This length differs with different specimens. 2. How much wire is necessary for the field magnet of the dynamo described in No. 161, for the armature? A. Seven pounds on the field magnet and about ½ pound on the armature. 3. Are the tangents of the deflections of the tangent galvanometer proportional to the number of amperes or the number of volts? A. Amperes. 4. Is not the heating of wire due to the number of amperes, and not volts? If so, how can the expansion voltmeter described on page 451, Experimental Science, record volts? A. Volts and amperes cannot be separated. If $\frac{E}{R}=C$, C×R=E. The instrument may be constructed as a voltmeter or amperemeter.

(2033) S. E. M. writes: 1. Will you state the process of manufacture of porous cups for galvanic or secondary batteries, and the materials used with the clay? A. They are made of unglazed clay by baking in a kiln. 2. May such cups or plates of the same materials be manufactured of a greater degree of porosity than is given to such cups and plates as ordinarily made, and if so, by what process? A. By mixing sawdust or sand with the material its porosity may be increased. 3. Is there any treatise upon the manufacture of the article? A. We know of none, and it is not easy to find out the approved formulas in practical use by manufacturers.

(2034) O. L. J. asks: 1. The wire for the armature ring is to be varnished with shellac and left to dry before winding on the spool. Will it make any difference if I do as follows? Shellac the paper on the spool and wind one layer of wire. Then carefully shellac this layer of wire and let it dry. Wind another layer, shellac, and let dry, and so on until the required thickness is obtained. What is the object of shellacking the wires? A. Your plan will answer. The wires are shellacked to prevent Foucault currents in the armature core. 2. Can the motor be run by a set of sulphate of copper batteries, using copper and zinc plates? If so, how many cells should I use, and what size of plates? Would this require any difference in construction of motor? A. The sulphate of copper battery is not well adapted to running motors. A motor to be run by a sulphate of copper battery should have the same resistance as the battery. 3. What size of wire should I use in connecting the battery with the motor? A. No. 16. 4. How thick is No. 18 wire (of any kind) Am. W. G.? A. 1·024 millimeters Am. W. G.

(2035) G. R. B. asks: How can I put a brown finish on a gun barrel or rifle? A. Mix 16 parts sweet spirit of niter, 12 parts of solution of sulphate of iron, 12 parts butter of antimony, and 16 parts sulphate of copper. Let it stand 24 hours, add 500 parts rain water, and it is ready for use. The above is to be applied to the perfectly clean and polished barrel, in whose cleaning lime water may be used and allowed to stay on for 24 hours. One or more repetitions of the process will be necessary. Finally clean up and polish with sweet oil.

(2036) A. W. writes: 1. I want to find out, if possible, how to make an ink (black) or paint which when drawn with on common blank paper will fade when heated, or a composition for a crayon which will write black on blank paper and which will disappear entirely when heated. A. Use a dilute solution of starch colored with a little iodine. 2. I would like to know how to soften common colored crayons, such as are used for blackboards in schools, so I can use them on blank paper for sketching, etc. A. You cannot soften them.

(2037) W. R. W. asks how an induction coil is made with a brass regulating tube. A. The coil is made in the usual way. It is supported at one end, and the regulation is effected by sliding a brass tube over the exterior of the secondary coil.

(2038) G. W. M. asks (1) what to apply to type on which kerosene has been spilled to make it "take" ink. A. Kerosene ought not to interfere. Brush off with boiling water and a stiff brush. 2. Refer me to some good work on wood engraving, suitable for one learning the art. A. We recommend Brown's "Wood Engraving," $1, also Emerson's "Wood Engraving," $1.

(2039) C. C. L. asks how to make carbon paper such as is used in writing on yellow telegraph operator's paper. A. Mix by heat beeswax, lard oil, and lampblack or other solid pigment, and apply to the paper with a hot iron.

(2040) G. W. C. asks the physiological process by which we feel a soreness of the muscles the day after prolonged and unusual exertion. A. It is presumably due to a phase of inflammation brought about by unusual exertion of the parts.

(2041) W. B. R. asks for a white substance that will dissolve in gelatine, which is transparent, so it can be used as a substitute for opal glass transparency. A. Your best line for experiment would probably be to use shellac or some similar gum dissolved in alcohol and added to the gelatine.

(2042) P. J. W. asks the best method of restoring the luster on an old gutta percha walking cane that has become dingy and scratched from usage. A. Use very fine emery followed by rottenstone and water Blotting paper may be used in its application.

(2043) A. L. asks for a receipt for a glue that will make leather adhere to iron. A. Add about 5 per cent of glycerine to good glue, and just before using add 5 per cent extract of oak bark or tannic acid. Use thick and hot.

(2044) F. E. F. asks for a cheap fireproofing for wood. I want a mixture in which to saturate large quantities of wood, to be painted afterward. A. Several formulas have been published. One is as follows: 33 parts chloride of manganese, 20 parts orthophosphoric acid, 12 parts carbonate of magnesia, 10 parts boracic acid, and 25 parts chloride of ammonium in 1,000 parts of water. This and one or two other methods are given in "Facts Worth Knowing," $3.50 by mail. Also see answer to query No. 986.

(2045) C. A. McM. asks (1) how many six inch Grenet batteries it will take to run a six candle power incandescent lamp. A. 8 to 10. 2. Would it be better to get 12 inch same kind of batteries? A. Not for this lamp. 3. How many Leclanche disk batteries will it take to run the same lamp? A. It would take a large number of Leclanche batteries. Probably not less than 60 cells, connected 6 in parallel and 10 in series.

(2046) A. F. asks: 1. What ampere and voltage is required for spark coil; wire core, 1 by 6 inches, No. 16 magnet wire 5 pounds? A. Use four or five volts E. M. F. and one ampere of current. 2. Does it lose in amperes all it gains in volts? A. No. 3. How long a spark would said coil make with a given current? A. You might get a ⅛ spark from the coil you describe.

(2047) E. D. asks regarding the lasting qualities of artificial ice and natural ice; which will last the longest, temperature in each case being equal? A. One will last as long as the other, all things being equal.

(2048) J. D. writes: Dynamite is said to "blow down." Is its force any greater down than in any other direction? A. No; its energy is equally expended in all directions.

(2049) L. M. T. writes: 1. I have made a small dynamo machine as described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 161. The armature, which is of the Siemens type, wabbles slightly, and is also loose in its bearings, so that when running at a moderately high speed, it vibrates. Would this be a detriment to the machine in its not furnishing as much current as it would if it were not in the condition described? A. Without doubt the machine would give better results if more perfect. 2. If this machine were in order, so that it furnished the amount of current designed for it to produce, would it "form" and charge an accumulator made of two plates of 1-16 inch lead, 10 inches wide and 3 feet long, wrapped up in a spiral form and immersed in 1 part sulphuric acid and 10 of water, and having about 10 square feet of active surface? If so, how is it done? A. You can form the battery by connecting it with the dynamo for six hours, then discharging it and again connecting it with the dynamo in the opposite direction for about 5 or 6 hours, again discharging the battery and charging in the opposite direction for 6 hours, and so on until the battery has been charged and discharged 10 or 12 times. The battery should always be charged in the same direction after forming. 3. Why is it that when the connections are made on the machine as described in said SCIENTIFIC AMERICAN SUPPLEMENT, No. 161, so as to shunt the current off the machine, *i. e.*, by placing a wire between the binding posts and running a wire from each of said posts, that the current will not flow through the wires leading from the posts, but flows through the most direct route back through the armature and field magnets, and thus throwing the belt off? For what purpose is resistance used in connection with dynamo machines? A. The current always takes the path of least resistance. Resistance is generally used in connection with shunt-wound dynamos. It is placed in the field magnet circuit, and is varied for the regulation of the current.

(2050) Dynamo asks: 1. Would not a solid iron casting do for the field magnet of the simpler electric motor? If so, what kind of iron would be the best to make it out of? A. A casting of soft gray iron will answer for the field magnet of the simple motor. For convenience in winding, it might be made in two pieces well fitted and bolted together at the ends. 2. In forming the armature ring, would an iron ring do just as well as the wire? If it should, what kind of iron would be the best? A. Iron wire is preferable to solid iron for the ring. 3. As the armature ring is insulated with tape, why would not a wooden ring do just as well? Not that I want to make it that way, but as it is insulated, what good does the ring do? A. The iron increases the inductive effect of the field magnet. There is no insulator of magnetism. 4. In forming the field magnet, instead of having only 33 ft., I have got 36½ ft. in it? Will the extra 3 ft. make any difference? A. It will make no material difference. 5. In winding the field magnet, what is the reason it has such magnetic force when it is insulated with tape and the wire is covered? A. See last clause of answer to No. 3.

(2051) F. F. C. writes: 1. It is stated in Tyndall's pamphlet on elementary lectures in frictional electricity, that "Frictional electricity has to pass on or through ponderable matter to pass from one point to another." Now in the double barometric tubes of Cavendish how is it that electricity passes from one mercurial surface over to the other? Or is not the space above the mercury in barometer a perfect vacuum? If not, why? A. The space above the mercury in a barometer is not a perfect vacuum. It contains a little air and vapor of mercury. 2. In Hopkins' "Experimental Science," pages 430 and 431, it states that when 12 cells are connected in series, each having a resistance of 5 ohms, the total internal resistance will be 60 ohms; and when the same cells are connected parallel, the resistance of the whole battery is only 5-12 ohm. What is an explanation of this great difference in the two arrangements? I should think the internal resistance in the second case would be 5 ohms for the whole battery. A. The statement is of the most elementary kind, and should need no explanation. Consider each cell as representing a piece of wire of 5 ohms resistance. Twelve such pieces put in parallel would give twelve times as good a passage for the current as a single one. Twelve pipes in parallel would give twelve times as good a passage for water as a single one. 3. What chemical changes causes molasses candy, while hot, when pulled to become a lighter color? A. A difference in the grain, owing probably to mechanically included air as the cause. There is no chemical change involved. 4. Why does not copper with sulphuric acid give hydrogen instead of sulphur dioxide, while zinc and sulphuric acid gives hydrogen? A. Electro-negative metals having low affinity for oxygen all act in this way. They cannot decompose readily the molecule of water, but can reduce sulphuric oxide. Zinc in sulphuric acid attacks the water molecule only. Why it does not reduce the sulphuric oxide is impossible to say.

(2052) J. F. M. asks: 1. How to mend rubber boots so they will stick and not come off. A. Use India rubber cement or gutta percha dissolved in bisulphide of carbon. See our SUPPLEMENT, Nos. 249, 251, and 252. 2. Do they employ heat to put on the patching? A. Yes, if gutta-percha is used; very little if India rubber cement.

(2053) A. J. K. asks: Is there any flexible tubing, like rubber tubing or other material, made that will stand the action of gasoline? A. Good quality vulcanized rubber tubing will do this for a considerable time.

(2054) J. M. C. asks: 1. Will you kindly tell me how to treat new cotton cloth (cheese cloth for example) which upon contact with water is impervious to it, so that the cloth will instantly absorb upon contact? A. Boil in a five per cent solution of caustic soda, followed by boiling in a five per cent solution of bleaching powder. Immerse in dilute muriatic acid, wash, treat again with soda and wash. Probably a single treatment with soda followed by washing will answer your purposes. 2. What material will absorb the greatest amount of water as compared to its bulk? A. Cotton prepared as above (absorbent cotton of the druggists) or sponge among common substances.

(2055) M. R. asks: 1. How to make a hole in the bottom of a perfume bottle? A. Drill it with a file whose end has been broken off, so as to give a rough cutting surface. The file should be worked by a carpenter's brace or drill stock. Use turpentine and camphor as lubricant. 2. How or where to get best information on copper and steel plate engraving and printing. A. Several manuals have been published, treating of such subjects, which we can supply by mail on application.

(2056) J. H. F. asks: 1. A simple test for the detection of acid in illuminating oil. Something more accurate than litmus paper. A. Shake a sample of the oil with water, color the water with litmus, or violet phenol phthaleine solution, and if it does not

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show an acid reaction, evaporate on a water bath until concentrated. If it still shows none, the oil is free from sulphuric acid. Or the water may be evaporated with a little white sugar on a water bath. Sulphuric acid if present will darken or blacken the sugar. 2. How many volumes of gas or vapor will one volume of crude oil produce when distilled? A. This all depends on the circumstances of the case. At a high temperature one hundred or more cubic feet may be produced. By "cracking," the quantity of vapor is also increased. A definite answer cannot be given. 3. A tank of oil is situated on a hill. Commencing at the tank, we lay a four inch pipe half way down the hill, and a six inch pipe the balance of the way. Will this discharge more oil than it would if the position of the pipes was reversed? A. It is immaterial. 4. Suppose a still is discharging gas through a two, three, or four inch pipe, say 200 to 400 feet long, with the gas burning at the end of the pipe. If a partial vacuum was created in the still, could the fire travel back through the pipe and explode the still? A. Yes; even if no explosion took place, a very violent fire might be produced in the still, which might produce very serious results.

(2057) R. T. D. writes: I live in a semitropical climate, where beer, imported from England, sometimes arrives soured and unfit to drink. This is thrown away, which seems a great waste. Cannot it be converted into table vinegar? A. No. The percentage of alcohol is too low.

(2058) M. H. C. asks: 1. Please tell me themost convenient and practical way for cleaning oil cloth. A. Wash with soap and water. 2. What is the best manner to clean hair brushes? A. Wash with weak solution of washing soda, rinse out all the soda, and expose to sun. 3. Give names of the materials and the proportions required for the Leclanche cell. A. Outer cell, zinc rod unamalgamated in solution of sal ammoniac; inner porous cell, a plate of carbon surrounded by a mixture of 60 parts graphite and 40 parts pyrolusite (binoxide of manganese), both well sifted free from dust.

(2059) A. O. C. asks for the process of making rubber combs. A. The rubber is vulcanized in shape and the teeth are cut out of the solid. We refer you to our SUPPLEMENT, Nos. 249, 251, and 252, for details of India rubber manufacture.

(2060) S. P. A. asks: Do stone and other minerals grow in size? A. They do not, properly speaking. The genesis of minerals is a very comprehensive study, and involves a knowledge of many complicated reactions. Minerals are constantly being formed in the operations of nature, one mineral changing into another by loss of some of its constituents or other changes. Carbonates are continually being deposited from water holding them in solution, and even the acid products of decaying vegetation play an important part in mineral history.

(2061) A. W. P. asks: 1. Could the 8 light dynamo described in SUPPLEMENT, No. 600, be used to charge a storage battery at a distance of 40 or 50 rods? A. Yes; provided you use a conductor of sufficient size, say No. 9 or 10 copper wire. 2. Could a sufficient number of batteries be used to light the same number of lamps as from dynamo direct? How many storage batteries would be required? A. You can light the same number or a greater number. To run 50 volt lamps you should have 26 cells. For 20 volt lamps, 11 cells. These will run respectively 25 and 10 lamps or any smaller number. 3. Could enough current be generated during 10 hours of the day to light 8 50 volt lamps for 3 or 4 hours each night? A. Yes; you could probably charge your batteries in 7 hours. 4. What size and kind of wire would be required from dynamo to battery and also from battery to lamps? A. See No. 1. The distance of the lamps from the battery if near No. 16, would answer. 5. Is there a book on the above subject? A. Consult Badt's "Incandescent Wiring." 6. What kind of battery would be best for running simple electric motor described in "Experimental Science"? Would the large Bunsen cell, called by dealers nickel plating battery, run it? How many cells would be required to start it and how many to run it to its full capacity? A. The large Bunsen would answer very well. You would need 6 or 8 cells connected two in parallel.

(2062) N. B. asks: How is tin stained different colors, as seen on trunks? A. Use as a body shellac or gum sandarac varnish. To make it adhere add to it ½ part of boracic acid to 1,000 parts of lacquer. Color with suitable pigments, such as gamboge, Prussian blue, or carmine. Aniline colors may be used, but tend to fade. Excellent results may be attained by adding a little castor oil, which makes the lacquer much tougher.

(2063) J. C. G. asks: 1. Is it as safe to walk on an electric railroad track during a thunder storm as anywhere else? A. Yes. 2. Are houses two hundred feet from the wires anywise protected by them? A. Not to any perceptible extent. 3. Are persons with dynamos and engines in a power house as safe or safer than anywhere else during a thunder storm? A. They are rather more exposed than elsewhere.

(2064) F. E. D. asks for a receipt for softening hard water, the same to be used for bathing purposes at our gymnasium. We use hard water, which is not the best for bathing purposes. A. The proper treatment depends on the nature of the water. If due to gypsum, it cannot be cured. If due to bicarbonate of lime, an addition of an equivalent of lime to each equivalent of the bicarbonate will precipitate the lime, after which it should be allowed to settle.

(2065) E. B. asks: Please tell me which is the best way to make beer clear (clean) and also give it a red color. A. Dissolve 1 ounce isinglass in 1 quart weak vinegar or hard beer, add good beer enough to make 1 gallon. This is called finings. To use it take for a barrel of the beer 1 or 2 pints and beat it up with about a gallon or two of the beer in a bucket until it is frothy, then add to the liquor in the barrel, stirring well through the bung hole. Do not use artificial color. Caramel (burned sugar) will darken it.

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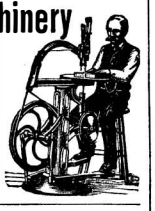

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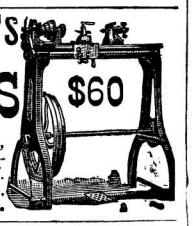

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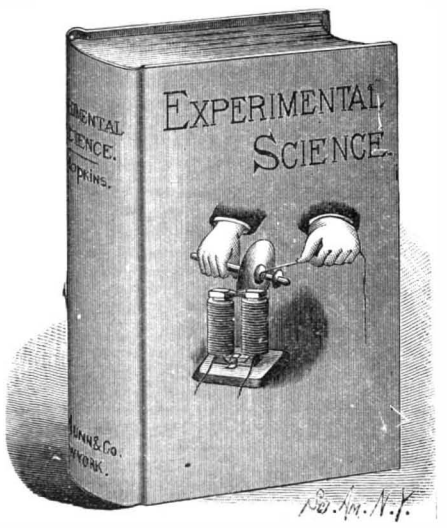

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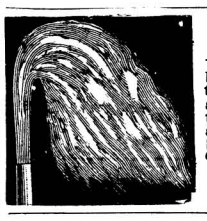

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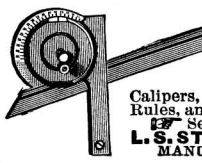

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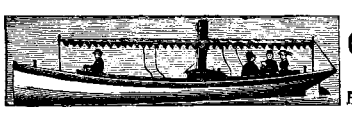

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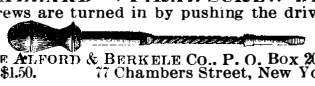
$1.50  $1.50
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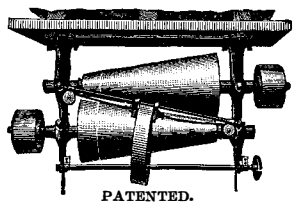

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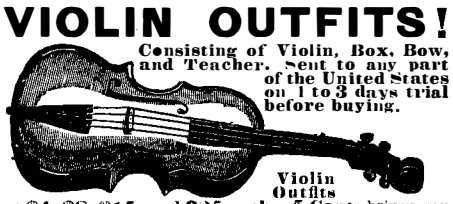

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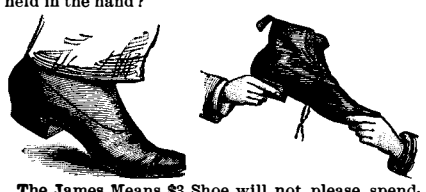

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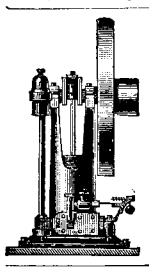

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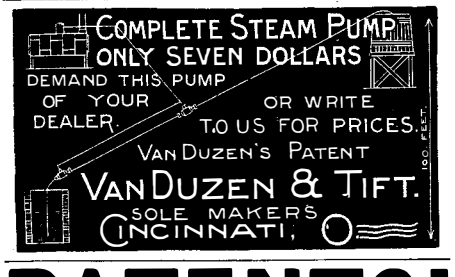

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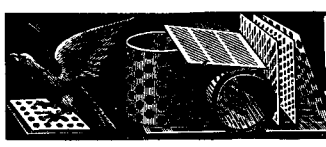

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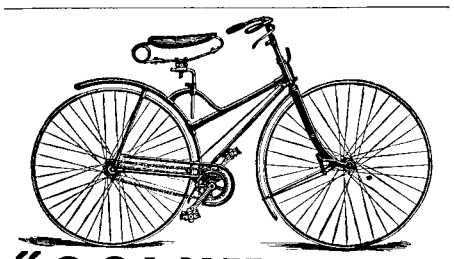

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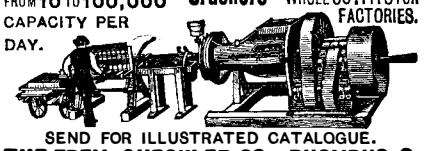

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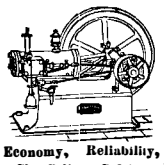

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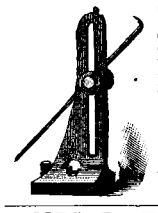

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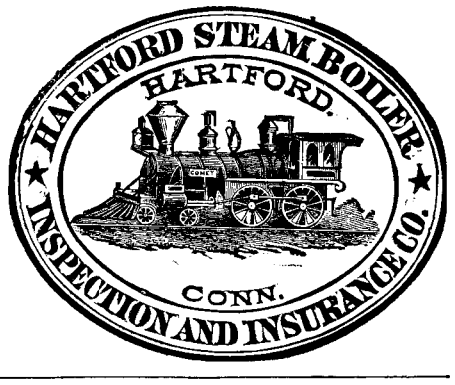

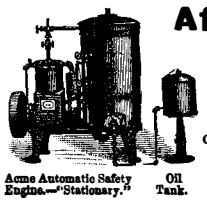

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